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DRAFT REPORT



PRELIMINARY INVESTIGATIONS  
HISTORICAL EMISSIONS INVENTORY  
MONTANA AIR POLLUTION STUDY

Prepared for:  
Air Quality Bureau  
Department of Health and Environmental Sciences

STATE DOCUMENTS COLLECTION

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Prepared by:  
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Missoula, Montana

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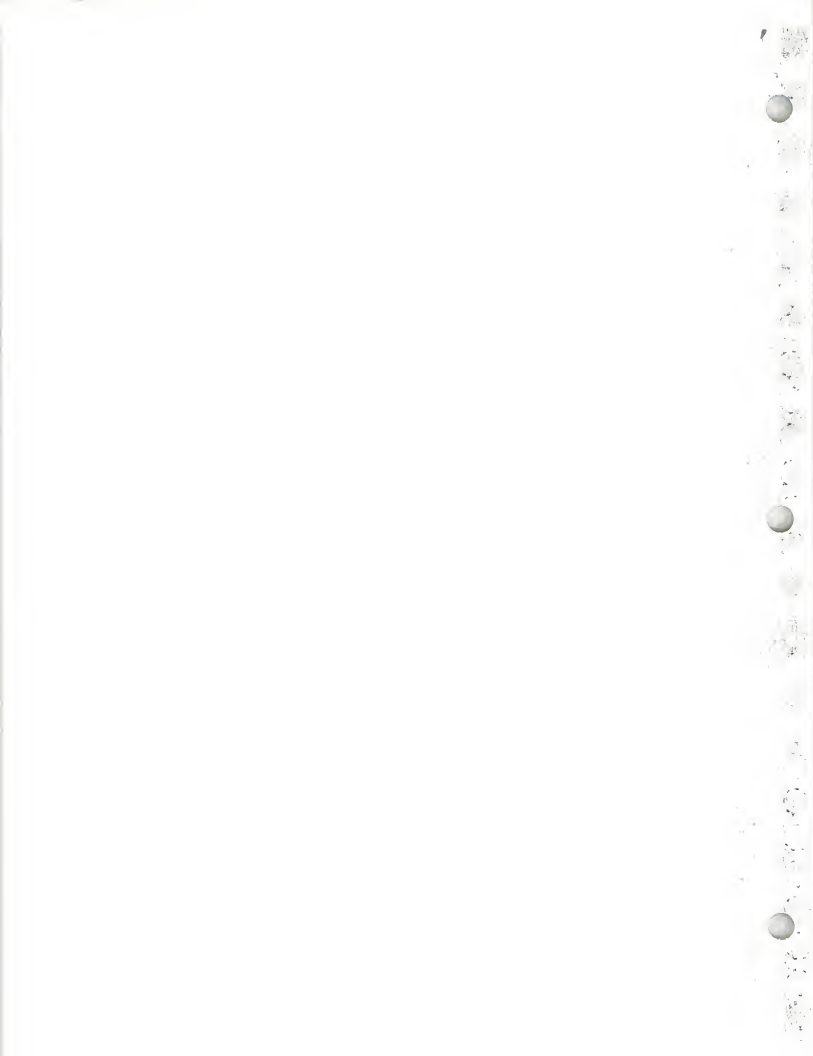


## INTRODUCTION/ACKNOWLEDGEMENTS

The following report is a summary of information obtained by Historical Research Associates under contract to the Montana Air Quality Bureau for a portion of the Montana Air Pollution Study (MAPS) to be known as the "Historical Emissions Inventory." This part of the inventory is a feasibility study to determine the extent and quality of data available for assessing air pollution sources in the Butte-Anaconda metropolitan area from 1880 to circa 1970. A technical analysis of the information gathered during this phase will be the basis for a determination by the Air Quality Bureau to continue the "Historical Emissions Inventory" or abandon the historical research.

This records research relied heavily upon the cooperation of numerous individuals and agencies. We appreciate the assistance offered by the following:

- Montana Air Quality Bureau
- Montana State Historical Society
- University of Montana Library and Archives
- Montana Bureau of Mines
- Montana College of Mineral Science and Technology Library
- World Museum of Mining (Butte)
- Butte Public Library
- Anaconda Department of Public Works
- The Anaconda Company: Environmental Engineering Department
- Montana State Prison: Tag Plant
- Montana Department of Justice: Registrar of Motor Vehicles
- Butte-Silver Bow Treasurer's Office
- Butte District Court





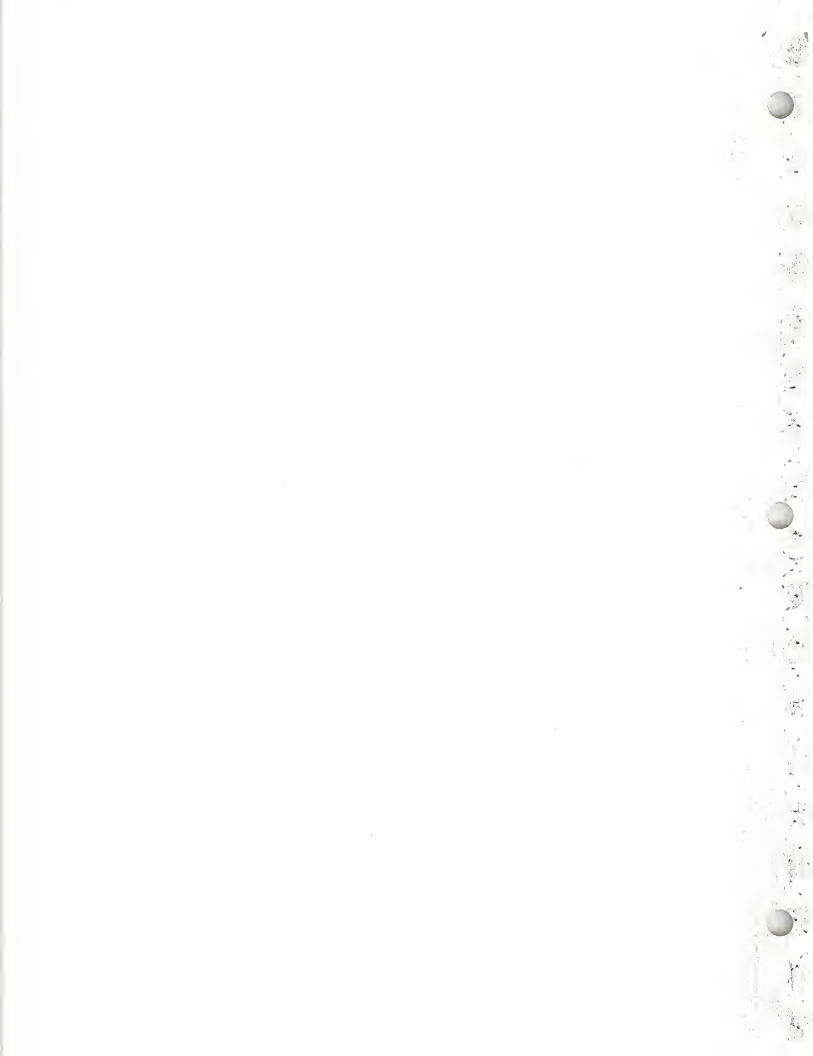
## I. METHODOLOGY

The purpose of the Historical Emissions Inventory is to identify potential sources of air pollution in the Butte-Anaconda metropolitan area for the period from 1880 to 1970. It includes research into both commercial and domestic activities that may have had an impact on air pollution levels in those two communities. This phase of the project was designed as a feasibility study or "information search." Its objective is to provide a sampling of information with an evaluation of sources and the potential benefit of more comprehensive historical investigations.

For commercial-industrial activities, researchers attempted to identify the plant location, period of operation, equipment and/or process, and production statistics. Since the mining and metallurgy industries were outstanding factors in the development of Butte and Anaconda, much of the information pertains to those two activities. The seemingly disproportionate volume of information in this report for smelting activities is the result of that prominence and the availability of extensive writings concerning the mining and metallurgical processes generally, and in Butte and Anaconda specifically.

Domestic or residential sources of pollution are not so well documented. In this study, an attempt was made to locate sources of information pertaining to home heating, cooking, and indoor lighting; types and quantities of fuel consumed; motor vehicle statistics; street paving, sanding, and cleaning programs; and population statistics. Other non-industrial pollution sources considered for this report included catastrophic fires, open air burning (trash disposal) laws, and any suspected sources encountered during research with historical data.

With but few exceptions, the information required for this study is located within the state of Montana. Principal collections for use are those of the Montana State Historical Society (Helena), the University of Montana Library and Archives (Missoula), and the library of the Montana College of Mineral Science and Technology (Butte). Additional sources of information

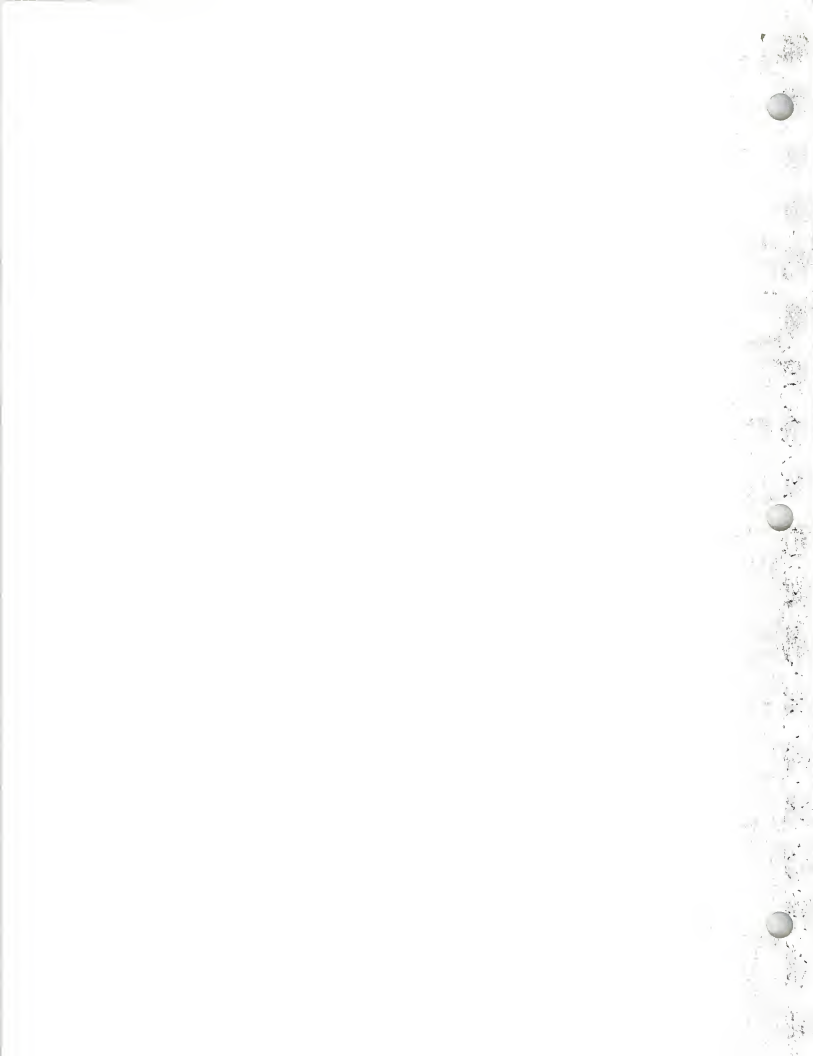


include state records for those agencies involved in monitoring and/or regulating operations that may result in air pollution, private company records, local libraries, and municipal office records. Some federal publications, especially those relating to the mining industry, were useful in this investigation.

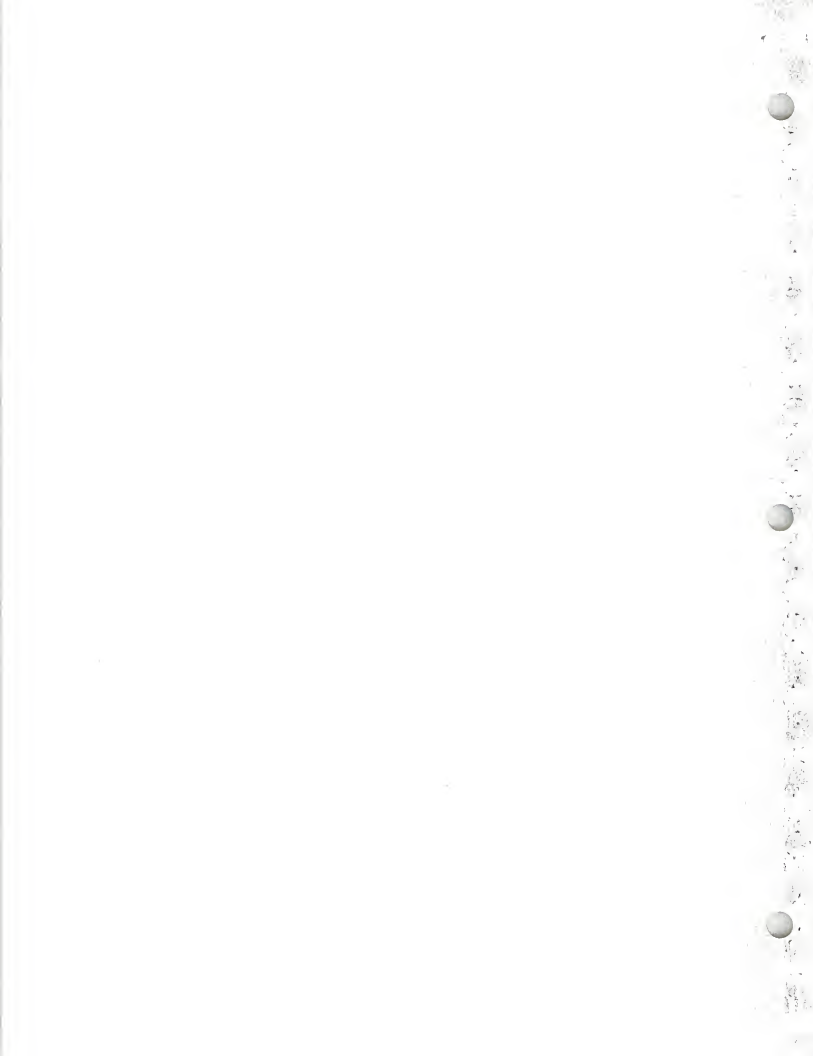
Some data sources included in this report must be viewed with a degree of skepticism, especially production statistics which may be elevated through brag or diminished for the tax record. It is essential, therefore, that bibliographic citations be considered when viewing any production statistic. Still, these suspect sources provide valuable information in topics such as ownership, equipment lists, and periods of operation. The questionable production statistics themselves will help establish a general view of air pollution levels when no other sources are available to corroborate the validity of those figures.

Researchers approached the project by first compiling a working bibliography of general historical writings pertaining to the development of the two cities involved. A review of those items provided a list of industries active in the area, the names of mines, smelters, iron works, power plants, etc. The researchers used that list to search archival holdings and technical journals, looking for information on those specific operations. In addition, information on general processes used in the Butte or Anaconda industries was taken from those technical publications.

Although this is a review of sources, we have made an effort to provide an extensive view of selected operations in order that a technical consultant might make more accurate predictions as to the usability of the information available in determining historical levels of air pollution. The summary provided in the report is from files of photocopied articles, reports, book excerpts, archival documents, and notes which are now the property of the Air Quality Bureau. Rather than summarize or rewrite the technical discussions of plant operations or processes, Historical Research Associates has provided them in their original form in those files. Bibliographic citations throughout the report will aid readers in finding the applicable information



sources in the files or, possibly, in library or archival depositories for those without immediate access to the records of the Air Quality Bureau. Discussion of specific sources is included within the report.



## II. INDUSTRIAL-COMMERCIAL AIR POLLUTION SOURCES

### A. BUTTE

#### 1. *Mining and Ore Processing*

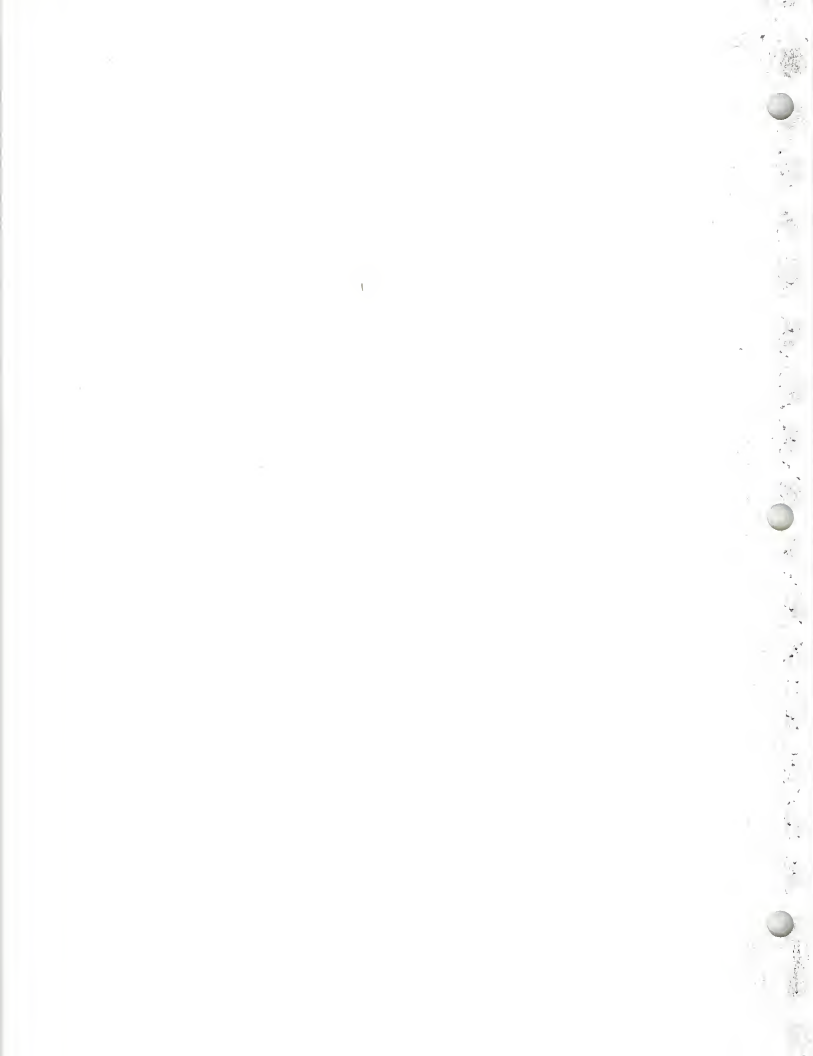
Historically, the most obvious industrial air pollution has come from the smelters built in Butte to process locally mined ores. In more recent years, smelting operations have moved away from the city, and blasting for open-pit mining operations has become a more important contributor to air pollution. A vast amount of material pertaining to mining and metallurgy in Butte and Anaconda is available. Therefore, researchers were unable to compile anything like a definitive bibliography of sources pertaining to those two industries. An evaluation of sources is given in this report with the recommendations for further investigations.

For data evaluation, operational information is provided for selected Butte smelters. Similar information for other plants is located in the sources already viewed. It was thought imprudent to expend further time and money on this aspect of the study without expert technical interpretation of information already obtained through research efforts. For the selected plants, information includes location, construction and termination dates, ownership, process, equipment, production statistics, and a bibliography of additional sources. Data is incomplete for certain of those categories in each of the smelter reports, indicating potential for additional research.

In addition to copper smelter statistics, information is included for the Timber Butte Milling Company, the Berkeley Pit operation, Domestic Manganese and Development Company, and Rocky Mountain Phosphates.

Information is available for stamp mills other than the Alice. The Alice operation is representative. Other mills in Butte included the Lexington, Dexter, Clipper, La Plata, Grove Gulch, Thornton, and Burlington (A /19).

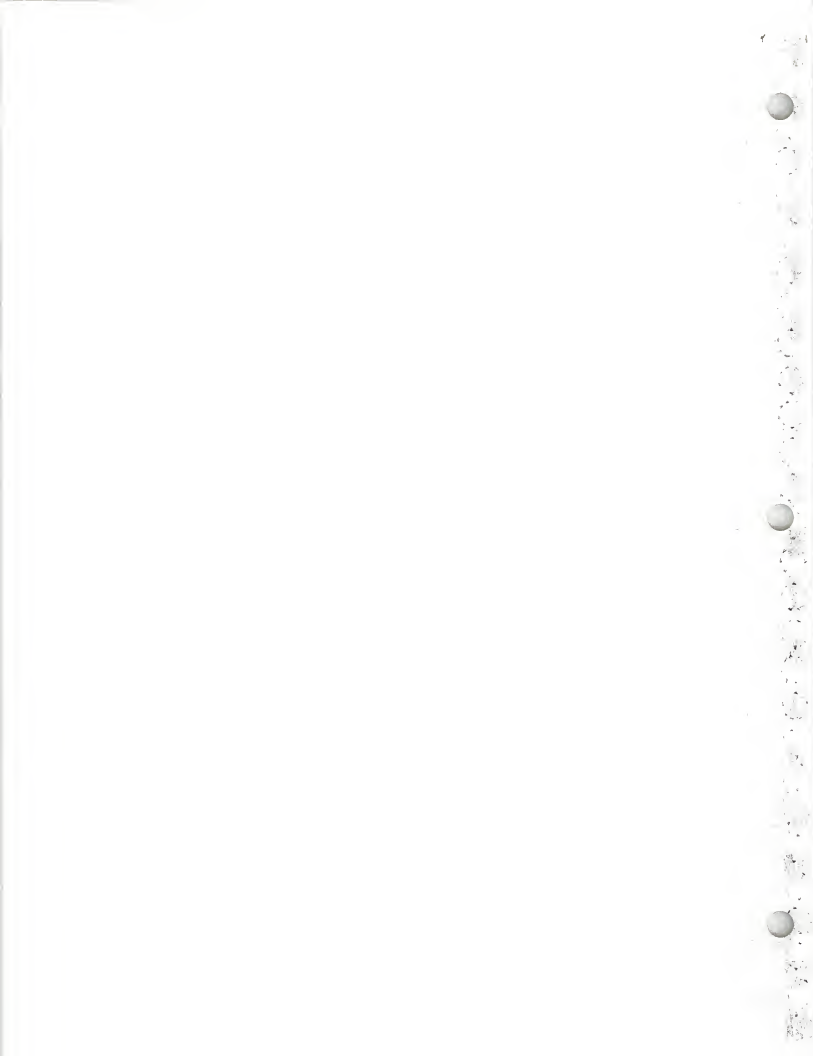
Air pollution was a noticeable problem in early Butte. Donald MacMillan, a graduate of the University of Montana, compiled a history of the attempts





to abate air pollution in the Mining City (see Bibliography). Much of that pollution came from an operation called "heap roasting." Smoke and fumes emitted by that process resulted in a heated controversy between those who saw the smoke as an economic necessity--a symbol of progress--and those who suffered from the ill effects.

Heap roasting was accomplished by dumping ore onto a layer of wood approximately two feet deep. The pile was then torched, igniting the sulphur in the ore and driving it off. The process usually required a month or more for completion (A 2/342). Adversaries of the heap roasting method won the battle when the Butte City Council passed Ordinance No. 186 in December, 1890. That law declared heap roasting a public nuisance and provided penalties for anyone using the process within three miles of the city. Roasting with the use of chimneys, however, was to be allowed.



BUTTE AND BOSTON  
(see also Boston and Montana Company)

LOCATION:

North of road that leads across the bridge to East Butte (A, 15/8).

CONSTRUCTED:

1885 - Smelter constructed (A 16/264, A 15/8).

1892 - Plant burned down--soon rebuilt (A 15/8, A 16/264).

TERMINATED:

1910 - Bought out by Anaconda Co. and presumably closed (G /1910). Note: Listing for the "G" file are followed by the year of the report rather than the page number as used in all other citations.

OWNERS:

1885-1888 - ?

1888 - Company reorganized with A. J. Davis as President, and D. L. Demmon as treasurer. Also bought Silver Bow Mill at this time and expanded rapidly (A 15/9).

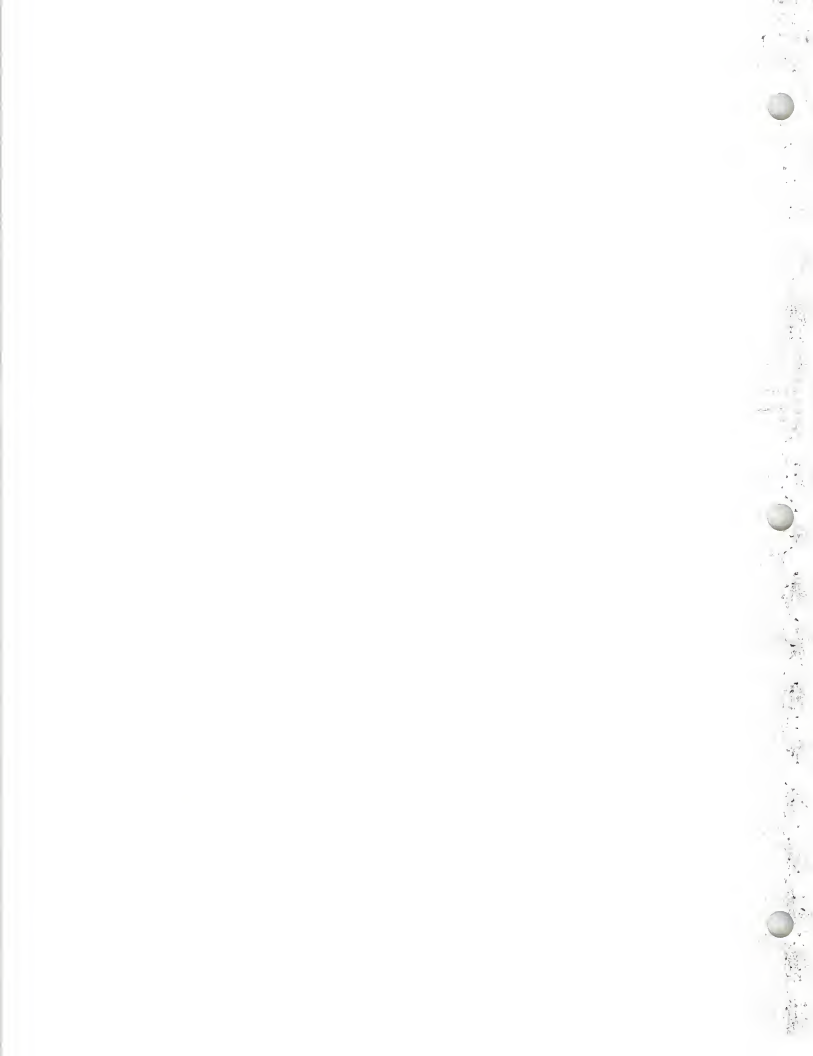
1895 - President, J. A. Coram; General Manager, Charles H. Palmer (A 47). A 47 mentioned consolidation of Butte & Boston with Boston & Montana.

1899 - Anaconda Co. (Amalgamated) acquired large interests in the Butte & Boston and Boston & Montana (A 54/212). A 54 refers to Boston Coalition Companies of Butte & Boston and Boston & Montana. A 28 refers to Butte & Boston and Boston & Montana together.

1900 - Raymer (A 1) says Butte & Boston had been leasing its smelter to Boston & Montana--no mention of consolidation.

1902 - Hofman (A 16) lists Butte & Boston separately from Boston & Montana.

Almost certain that coalition took place--need further research to determine how long it lasted.



## PROCESS:

"These works were started in 1885 with 4 Bruckner cylinders (8 by 18 ft.), 2 reverberatory matting-furnaces (hearths 22 by 17 ft., treating 5-ton charges), and 2 blast-furnaces, the larger being 96 by 36 in. at tuyeres and 11 ft. high. In 1889 2 O'Hara roasting-furnaces were added; later, 4 Allen-Brown-O'Hara furnaces; and, these giving satisfaction, the original O'Haras were remodeled to the Allen-Brown-O'Hara type, and the Bruckner cylinders thrown out. In 1892, when the plant burnt down, 8 Allen-Brown-O'Hara furnaces were in operation. The plant was immediately rebuilt, the Allen-Brown-O'Hara furnaces were repaired, but not the Bruckner cylinder. A new blast-furnace, 96 by 36 in. and 16 ft. high, was erected to take the place of the old small cupola. This furnace was originally provided with a bell-and-hopper feed, which proved too expensive. In 1901 the width of the new furnace was increased to 40 in. and the height reduced to 11 ft. Up to 1893 the blast-furnaces smelted little but roasted concentrates. The matting reverberatory-furnaces were remodeled and enlarged in 1895. The converter-plant was started in 1900. The present plant comprises 8 Allen-Brown-O'Hara roasting-furnaces (hearths 90 by 9 ft.), 4 matting-reverberatories (hearths 50 by 20 ft., the first furnaces of this size having been built in 1899-90), 1 blast-furnace 96 by 44 in. at tuyeres and 9 ft. high, and 3 horizontal converters with barrels 10 ft. 6 in. by 7 ft." (A 16/264)

## EQUIPMENT:

1885 - a) 4 Bruckner cylinders, 8' x 18'.

b) 2 reverberatory matting furnaces, hearths 22' x 17' (treating 5 ton charges) (H 1/27).

c) 2 blast-furnaces, 1 of which was 96" x 36" at the tuyeres and 11' high.

1889 - a) 2 O'Hara roasting furnaces added.

1889-1892

a) 4 Allen-Brown-O'Hara furnaces added. Original O'Haras remodelled to Allen-Brown-O'Hara type and Bruckner cylinders discarded.

b) 1892 - plant burned down but was immediately rebuilt.

c) After the fire the Allen-Brown-O'Hara furnaces were repaired.

d) Date uncertain--new blast furnace, 96" x 36" and 16' high, erected to take the place of old, small cupola.



1893 - Until this date blast-furnaces smelted little but roasted concentrates.

1895 - a) Matting reverberatory-furnaces remodelled & enlarged.

1896 - See A 42 for description of concentrator and flow chart.

1900 - a) New converting plant built capable of producing 900,000 pounds of copper monthly (A 1/48). See also A 28.

1901 - a) Width of new furnace increased to 40" and height reduced to 11'.

1902 - Equipment operating: ✓

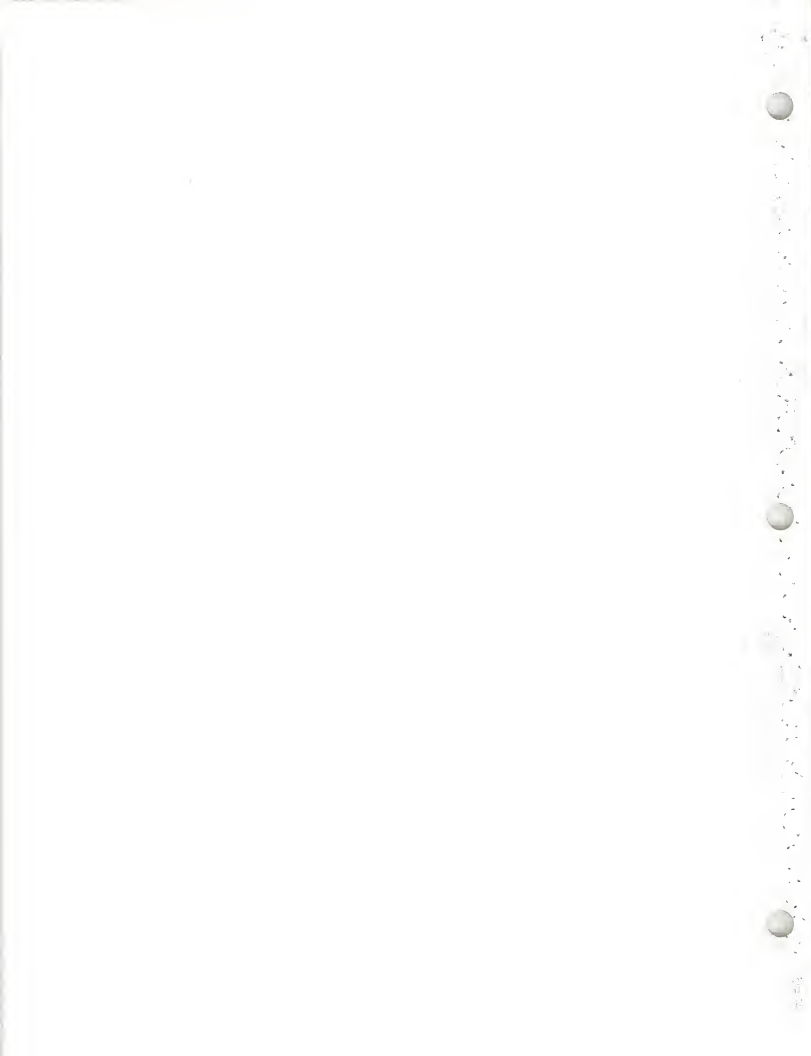
a) 8 Allen-Brown-O'Hara roasting furnaces, hearths 90' x 9'.

b) 4 matting-reverberatories, hearths 50' x 20' (first furnaces of this size having been built in 1899-90).

#### PRODUCTION STATISTICS:

None available from 1885 to reorganization in 1888 in sources researched thus far.

1889	- 1,103,125 lbs. of copper	(A 3/703)
1890	- 5,357,723 " "	(A 3/703)
1892	- 10,641,269 " "	(A 1/17)
1893	- 20,457,928 " "	(A 6/164) (A 1/51)
1894	- 57,937,633 (listed jointly with Boston & Montana)	(A 6/164)
1895	- 60,746,000 (listed jointly with Boston & Montana)	(A 6/164)
1896	- 4,500,000 " "	(A 6/164) (A 1/51)
1897	- no production figures in charts for that year	
1898	- 7,000,000 (listed separately)	(A 6/164)
1899	- 79,000,000 (listed jointly with Boston & Montana)	(A 6/164)

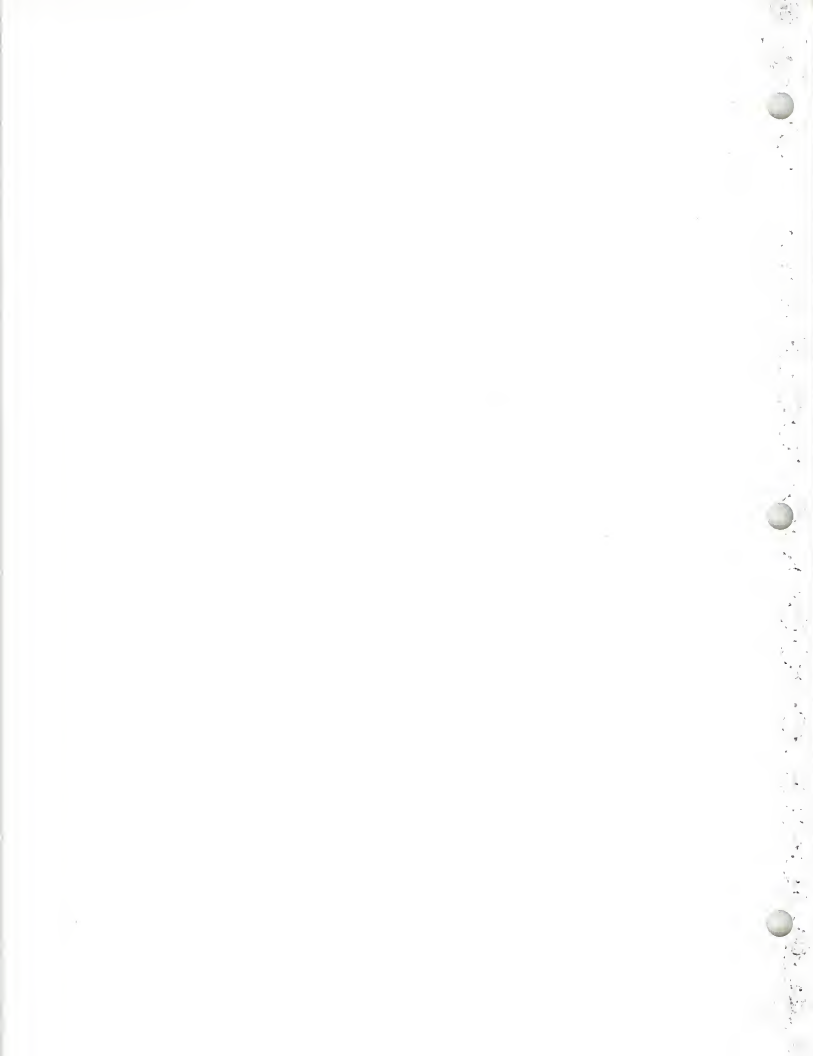




1900	-	16,950,000 (listed separately)	(A 7/169)
1901	-	58,028,746 (estimated jointly with Boston & Montana)	(A 7/169)
1901	-	22,200,000	(A 16/259)
1902	-	10,000,000 (estimated separately)	(A 7/169)
1907	-	9,209,650	(A 8)
1908	-	10,349,640	(A 8)
1909	-	14,010,500	(A 8)

OTHER CITATIONS FOR BUTTE AND BOSTON:

A 23, A 24, A 28, A 42, A 47, H1



## MONTANA ORE PURCHASING COMPANY

## LOCATION:

North and slightly west of Butte and Boston plant, on a hill west and above the town of Meaderville (A 15/10).

## CONSTRUCTED:

1893 - Smelter completed (A 1/23, A 16/264).

Fall, 1893 - Shut down briefly for repairs.

1901 - O'Hara furnaces destroyed by fire and not replaced (A 16/265).

August 28, 1902 - Fire burned and destroyed company concentrator, not rebuilt. Instead sent crude ore to Basin and returned concentrates to Butte to be smelted (A 7/170).

## TERMINATED:

Spring, 1906 - Montana Ore Purchasing Co. and all other Heinze properties were indirectly sold to Amalgamated (A 54/140). Need further research to determine whether Montana Ore Purchasing Co. smelter continued to operate after this date.

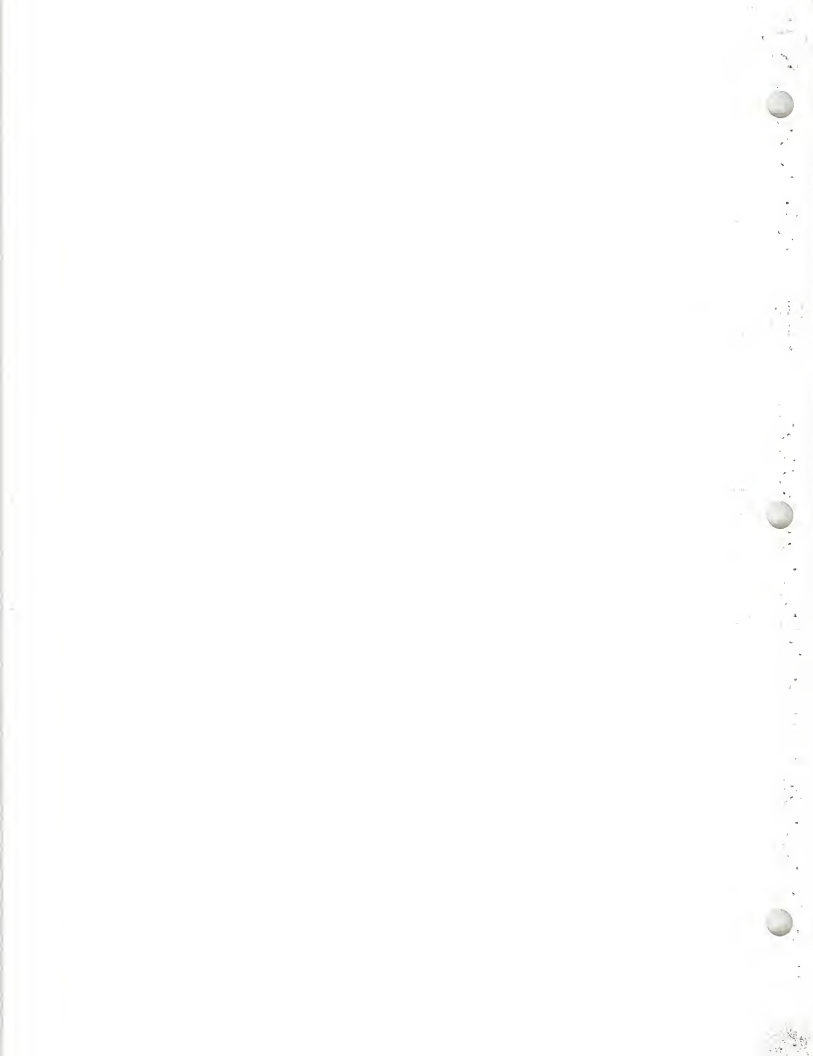
## OWNERS:

1892-1906 - F. Augustus Heinze (A 54/17, 18, 212).

1906 - Anaconda (Amalgamated).

## PROCESS:

"Ground was broken for smelting-works Oct. 17, 1892; first matte was tapped January 1, 1893. The ore was roasted in 2 Allen-Brown-O'Hara furnaces (hearths 9 by 100 ft., each treating 60 tons in 24 h.), and



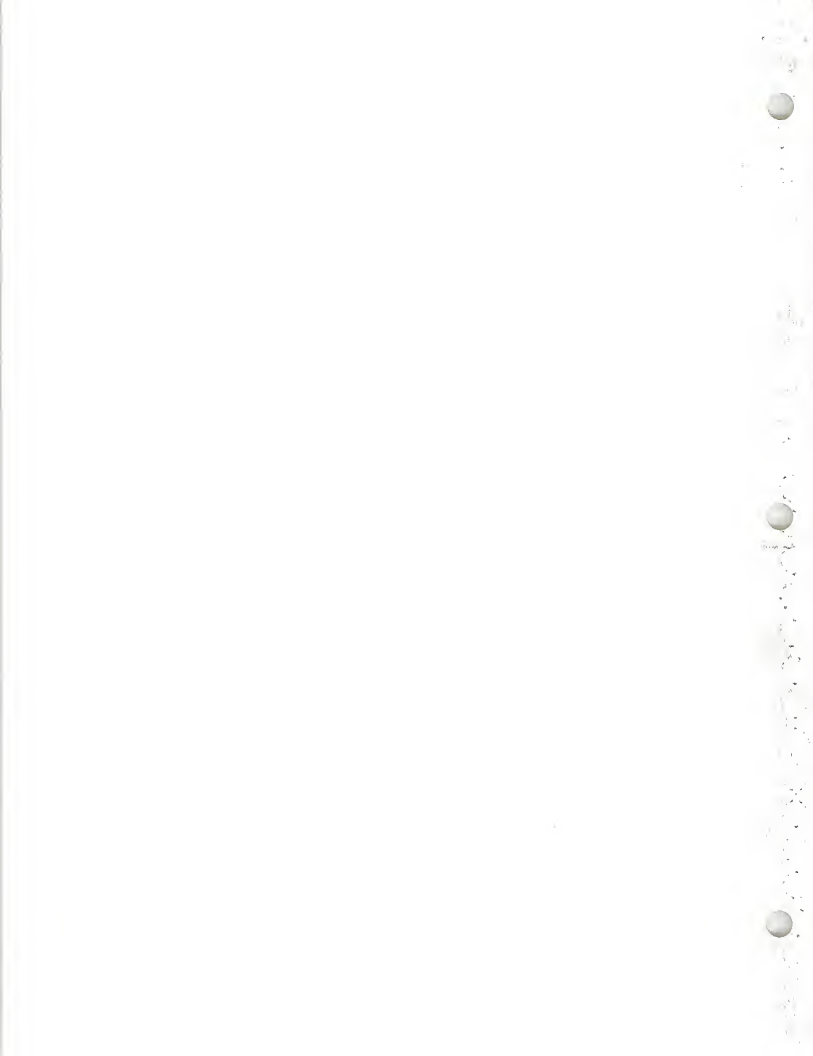
smelted in 2 reverberatory matting-furnaces (hearth 12 ft. 10 in. by 20 ft., and fire-box 5 by 6 ft; natural draught, stack 80 ft. high and 4 by 4 ft. in the clear, and charge 7 or 8 tons; time of melting 3.5 or 4 hours) and one blast-furnace, 42 in. diam. at tuyeres. After a year's run, the blast-furnace was replaced by 2 matting-reverberatories like those first built. In 1894, two Herreshoff furnaces (9 ft. inside diam., 5 hearths) were added to the roasting-department. These giving satisfaction, 8 more were erected at once, 30 in 1895, and 30 in 1899, making in all 70 Herreshoffs. The O'Haras were destroyed by fire in 1901 and not rebuilt. Early in 1894 the hearths of the matting-reverberatories were enlarged to 13 ft. 6 in. by 25 ft., fire-boxes, however, remaining 5 ft. by 6 ft.; at same time the fuel was changed from lump to slack coal, and undergrate-blast substituted for natural draught. These changes increased the tonnage per furnace for 24 h. by 10 or 15 tons. The furnaces were again enlarged in 1898, and 2 more were built in 1899, making 6 in all (hearth 16 by 33 ft., fire-box 6 by 8 ft., stack 80 ft. high and 5 by 5 ft. in the clear).

In January, 1900, 2 blast-furnaces (42 by 120 in. at tuyeres; 11 ft. from tuyeres to throat; cast-iron water-jackets) were blown in. These water-jackets giving much trouble by cracking, the furnaces were replaced by larger furnaces (42 by 160 in. at tuyeres and 10 ft. 6 in. in height) with steel water-jackets. The converting-plant was started in August, 1893, with 2 vessels of the Parrot type (5 ft. external diam.); in 1894 two more were added, and in 1899-1900 four more. Two barrel-converters (bowls 10 ft. 6 in. long and 7 ft. in diam.), installed in 1901, are in constant use, and the upright Parrot converters are worked only when these are unable to handle all the matte. It is the intention to erect 2 additional horizontal converters and to remove the remaining upright ones. The present plant comprises 70 Herreshoff roasters, 6 reverberatory matting-furnaces, 4 blast-furnaces, 2 horizontal converters and 8 upright ones." (A16/264-265)

Also note intermittent information in Edward D. Peters, MODERN COPPER SMELTING (1897).

#### EQUIPMENT:

- 1893 - a) 2 Allen-Brown-O'Hara furnaces, hearths 9' x 100' (each treating 60 tons in 24 hours).
- b) 2 reverberatory matting-furnaces, hearths 12'10" x 20', fire-box 5' x 6', natural draught, stack 80' high and 4' x 4' in the clear.
- c) 1 blast furnace, 42" in diameter at tuyeres.



- d) August, 1893 - Converting plant started with 2 vessels of the Parrot type, 5' external diameter.

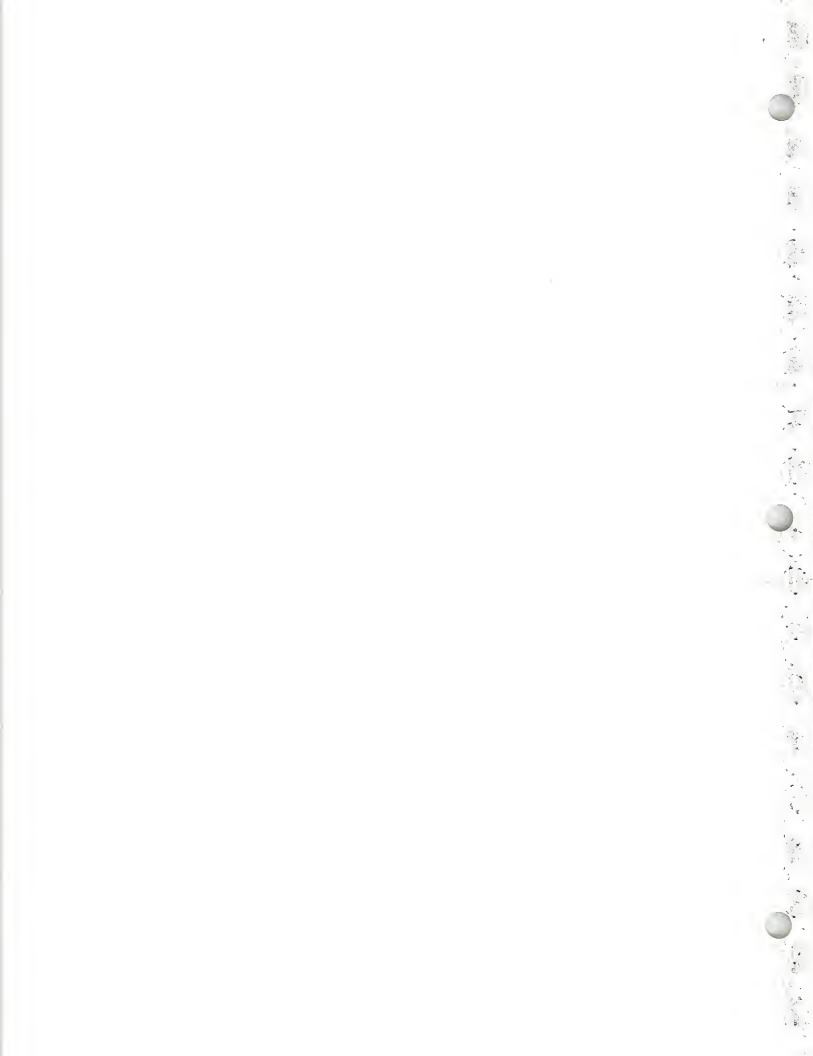
1894 - a) 2 more vessels of Parrot type added.

- b) Blast furnace replaced by 2 matting-reverberatories like those constructed in 1893.
- c) 2 Herreshoff furnaces, 9' inside diameter, 5 hearths, added to roasting department. These two proved satisfactory so 8 more were constructed at once.
- d) Early in 1894 the hearths of the matting-reverberatories were enlarged to 13'6" x 25', fire-boxes remaining 5' x 6'. (Apparently the two new matting-reverberatories were built to these enlarged dimensions.) Fuel changed from lump to slack coal and undergrate-blast substituted for natural draught (increased tonnage per furnace by 10-15 tons in 24 hours).

1895 - a) 30 Herreshoff furnaces added.

1896-1897

- a) Dimensions of new reverberatory furnace given
- |                                       |          |
|---------------------------------------|----------|
| 1. outside length of hearth           | 25'4"    |
| 2. outside width of hearth            | 17'2"    |
| 3. inside length of hearth            | 22'8"    |
| 4. inside width of hearth             | 14'6"    |
| 5. fire box (inside)                  | 6x6'     |
| 6. width of bridge                    | 2'10"    |
| 7. top of bridge to spring of arch    | 1'5"     |
| 8. top of bridge to center of arch    | 1'10"    |
| 9. width of flue                      | 1'11"    |
| 10. height of flue at neck            | 2'7"     |
| 11. height of flue-opening into stack | 4'6"     |
| 12. size of stack inside (square)     | 4'       |
| 13. spring of main roof               | 1'2 1/2" |
- Capacity: 70 tons per day on hot calcines and siliceous ores mixed. (H 5/470)
- b) Details of converter given:
- |                                     |        |
|-------------------------------------|--------|
| 1. outside height, feet             | 8.5    |
| 2. outside diameter, feet           | 5      |
| 3. blast pressure, lbs. per sq. in. | 5      |
| 4. initial chg., lbs.               | 2,500  |
| 5. maximum chg., lbs.               | 9,000  |
| 6. blows per 24 hrs.                | 16     |
| 7. weight of shell and lining, lbs. | 16,000 |
| 8. number of tuyeres                | 16     |



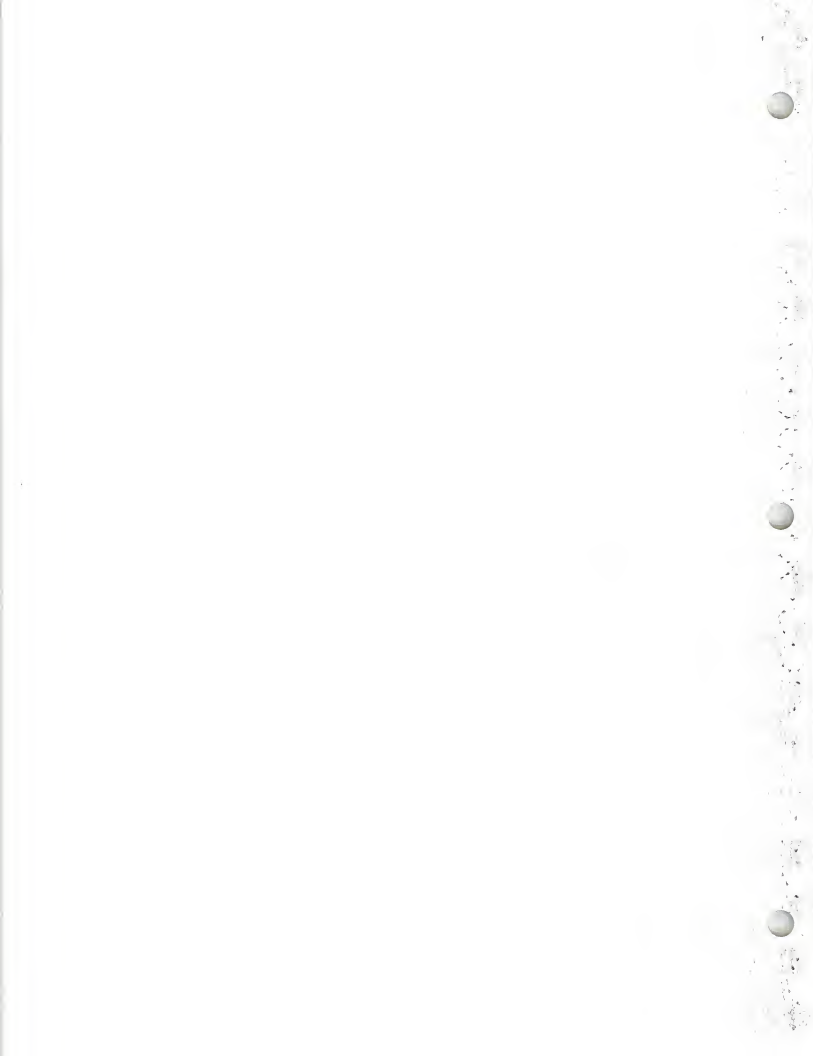


- 1898 - a) Matting reverberatory-furnaces enlarged again.
- 1899 - a) 2 more matting reverberatory-furnaces were built, hearth 16' x 33', fire-box 6' x 8', stack 80' high and 5' x 5'.  
 b) 30 more Herreshoff furnaces added.  
 c) Between 1899-1900 - 4 more vessels of Parrot type added.
- 1900 - a) 2 blast-furnaces blown in, 42" x 120" at tuyeres; 11' from tuyeres to throat, with cast iron water-jackets. Water-jackets broke--replaced by larger furnaces 42" x 160" at tuyeres; 10'6" in height with steel water-jackets.
- 1901 - a) O'Hara furnaces destroyed by fire and not replaced.  
 b) 2 barrel-converters, bowls 10'6" long and 7' in diameter installed.
- 1902 - Plant consists of:  
 a) 70 Herreshoff roasters  
 b) 6 reverberatory matting-furnaces  
 c) 4 blast furnaces  
 d) 2 horizontal converters  
 e) 8 upright converters.

After the shutdown of 1903, according to McNelis (A 54), Anaconda Co. (successfully amalgamated) nullified Heinze's holdings and activities. (Does this mean that the Montana Ore Purchasing Co. smelter operated minimally or not at all after 1903?)

#### PRODUCTION STATISTICS:

1893	-	8,400,000 lbs. of fire copper	(A 1/51) (A 6/164)
1894	-	12,293,686 " " "	(A 6/164)
1895	-	14,861,000 " " "	(A 6/164)
1896	-	15,049,066 " " "	(A 1/51)
1897	-	13,047,648 " " "	(A 1/51)
1898	-	13,084,000 " " "	(A 1/51)
1899	-	15,360,679 " " "	(A 1/51)
1900	-	22,257,563 " " "	(A 7/169)



1901 - 29,898,980 lbs. of fire copper (A 7/169)  
(estimated)

1902 - 30,650,000 " " " (A 7/169)

No production figures given for 1907-1909 in A 8.



# BUTTE REDUCTION WORKS (Colusa-Parrot Smelter)

## LOCATION:

Built on Silver Bow Creek just south of Butte (A 15/8).

## CONSTRUCTED:

- 1883 - Smelter constructed (A 15/8).
- 1891 - 112' high flue constructed in response to demands of the Butte City Council (A 1/22).
- 1902 - Reverberatory department destroyed by fire in August but was rebuilt and in operation again by October, 1902 (A 7/170).
- 1910 - Reduction Works sold to Anaconda Co. and closed, but the concentrator part of the plant was leased back to W. A. Clark, who used it for concentrating zinc from Elm Orlu mine (A 15/8).
- October 24, 1911 - Plant destroyed by fire and not rebuilt.

## TERMINATED:

- 1910 - Purchased by the Anaconda Co. and closed.

## OWNERS:

- 1883 - James McArthur, Larry Muldoon, Rudolph Siever, John and William Schauburger, David Murphy (A 15/8).
- 1885 - Taken over by employees of the Parrot Smelter (A 15/8).
- 1886 - Reorganization of smelter--now referred to as Butte Reduction Co. Officers were John Thompson, El Preston, James McArthur, and David Murphy (D 1/42).
- 1887 - Purchased by W. A. Clark (A 15/8).
- 1910 - Purchased by Anaconda Co. (A 15/8).



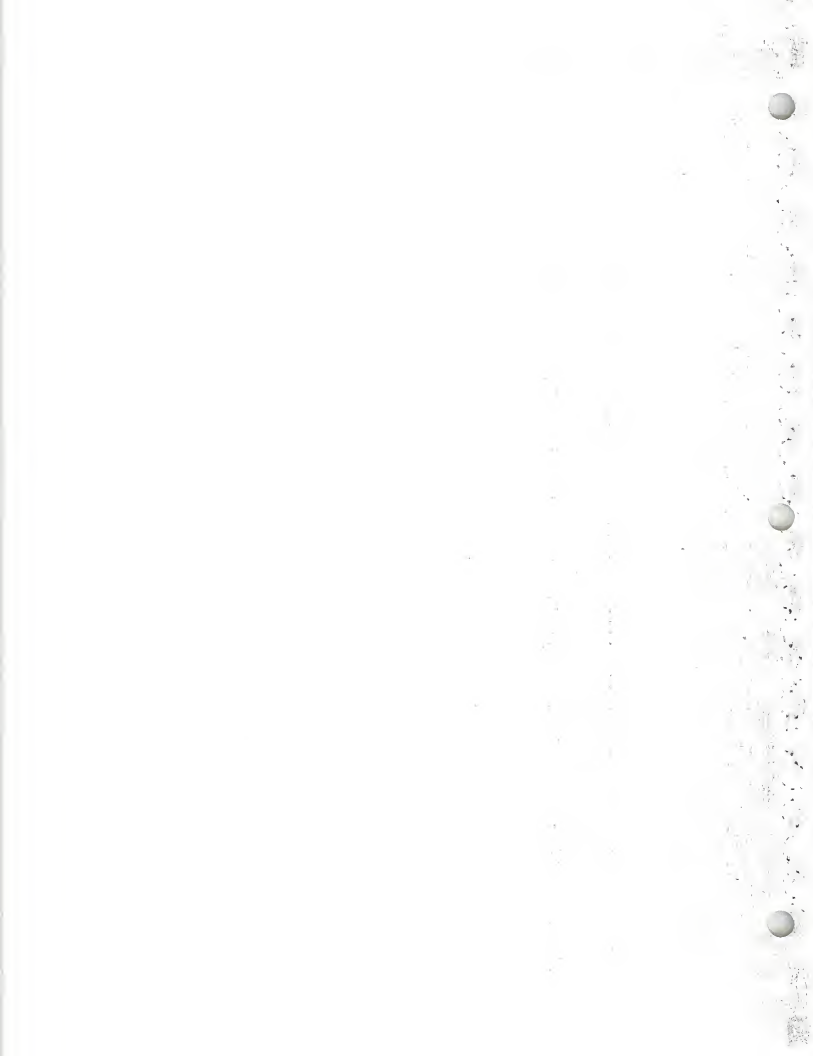
## PROCESS:

"This was started in 1885 by employees of the Parrot Smelter. At first, ore was roasted in heaps and then smelted (45 tons in 24 h.) in a 36-in. water-jacket blast-furnace. A long hand-reverberatory (hearth 100 by 14 ft.), erected in 1886, remained in operation until 1888, when it was cut in two, making 2 furnaces, 50 by 14 ft. each. In the same year the first Bruckner cylinder was installed (15 by 7 ft.; charge, 7 tons). In the fall of 1889, a second cylinder, 20 by 8 ft. was added. In 1894 the first 4-deck Wethey calciner was built, replacing one of the 50- by 14-ft. hand-reverberatory roasters and the 15- by 7-ft. Bruckner cylinder. Its work proving satisfactory, a second Wethey furnace was erected. The 50- by 14-ft. hand-roaster was replaced by a larger furnace, 75 by 5 ft., to be used mainly for roasting slimes. In 1898 the third, and in 1900 the fourth Wethey furnace was installed, replacing the remaining hand-roaster and Bruckner cylinder. The smelting capacity of the plant was increased in 1886 by the erection of a 96- by 42-in. Orford brick-furnace. The original 36-in. furnace was put out of blast and replaced in 1889 by one of 38 in. diam. at tuyeres. In 1897 a sectional blast-furnace of the United Verde Hot-Air type, 84 by 42 in. at tuyeres, replaced the two older furnaces. In 1900 a second rectangular furnace, 112 by 42 in. at tuyeres, was put in blast, and in 1901 the 84- by 42-in. furnace was enlarged to 112 by 42 in.

The first reverberatory matting-furnace (hearth 15 by 9 ft.) was erected in 1887; the second (hearth 18 by 11 ft.), treating from 12 to 15 tons in 24 h., in 1888. It was then customary to wet down roasted ore and shovel it into matting-furnace through side-doors. In 1889, hoppers were placed over the furnaces, and roasted ore was charged hot through the roof. This increased the smelting-capacity from 18 to 21 tons in 24 h. In 1896 a large reverberatory matting-furnace (hearth 35 by 16 ft.; capacity from 45 to 50 tons ore in 24 h.) replaced the two smaller furnaces. A second (hearth 45 by 16 ft.; capacity from 55 to 70 tons) was built in 1897; and in 1900 a third (hearth, 50 by 20 ft.; capacity from 85 to 100 tons). This last did so well that the 1896-furnace was rebuilt on the lines of the furnace of 1900. The present plant comprises 4 Wethey 4-deck calciners; 2 water-jacketed blast-furnaces (112 by 42 in. at tuyeres), and 3 reverberatory matting-furnaces (hearths 45 by 16 ft., 50 by 20 ft., and 50 by 20 ft.)." (A 16/262-263)

## EQUIPMENT:

- 1885 - a) Ore was roasted in heaps and then smelted (45 tons in 24 hours) in 36 inch water-jacket blast furnace.
- 1886 - a) Smelting capacity increased with the erection of 96" x 42" Orford brick-furnace. Original 36" furnace put out of blast by one of 38" diameters at tuyeres.





- b) Long hand-reverberatory furnace erected, hearth 100' x 14'.
- 1887 - a) 1st reverberatory matting furnace erected, hearth 15' x 9'.
- 1888 - a) Long hand-reverberatory furnace cut in two, making two furnaces, 50' x 14' each.
  - b) 1st Bruckner cylinder installed, 15' x 7' with a charge of 7 tons.
  - c) 2nd reverberatory matting-furnace erected, hearth 18' x 11', treating 12-15 tons in 24 hours.
- 1889 - a) Hoppers placed over furnaces, and roasted ore charged hot through the roof. Increased capacity from 18 to 21 tons in 24 hours.
- 1894 - a) 1st 4-deck Wethey calciner built replacing one of 50' x 14' hand reverberatory-roasters and the 15' x 7' Bruckner cylinder.
  - b) 2nd Wethey calciner built.
  - c) 50' x 14' hand-roaster replaced by larger furnace (75' x 15') to be used for roasting slimes.
- 1896 - a) Large reverberatory matting-furnace, hearth 35' x 16' (capacity, 45-50 tons of ore in 24 hours) replaced two smaller furnaces.
- 1897 - a) 2nd reverberatory matting-furnace, hearth 45' x 16' (capacity 55-70 tons) erected.
  - b) Sectional blast-furnace (United Verde Hot-Air type) 84" x 42" at tuyeres, replaced two older furnaces.
- 1898 - a) 3rd Wethey furnace installed.
- 1900 - a) 4th Wethey furnace installed.
  - b) 2nd rectangular furnace, 112" x 42" at tuyeres put into blast.
  - c) 3rd reverberatory matting-furnace, hearth 50' x 20' (capacity 85-100 tons) erected.
  - d) 1896 matting furnace redone like 1900 matting-furnace because 1900 equipment worked so well.
- 1901 - a) 1897 84" x 42" blast furnace enlarged to 112" x 42".



1902 - Plant consisted of:

- a) 4 Wethey 4-deck calciners
- b) 2 water-jacketed blast furnaces (112" x 42" at tuyeres)
- c) 3 reverberatory matting-furnaces, hearths 45' x 16', 50' x 20', and 50' x 20'. (A 16/262-263)

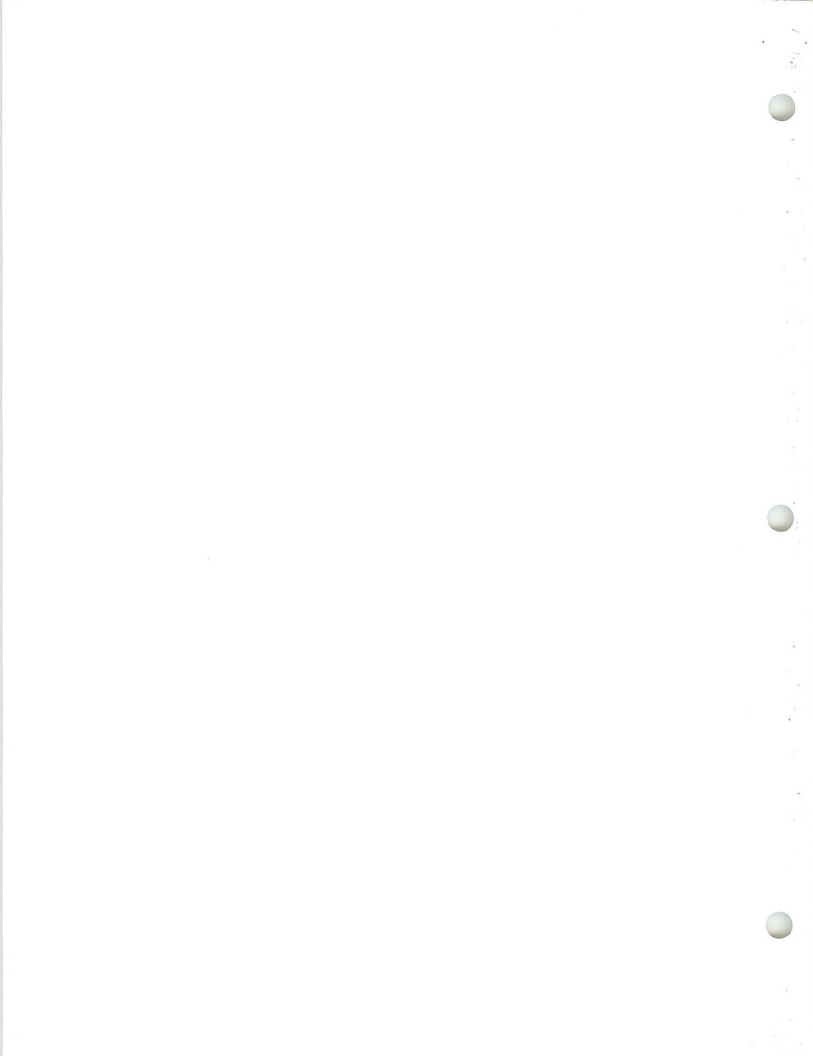
1907 - a) 700-tons concentrator built (capacity 1200 tons in 24 hours).  
(0 /210)

#### PRODUCTION STATISTICS:

1884	-	2,000,000 lbs. of copper	(A 3/703)
1885	-	2,500,000 " "	(A 3/703) (A 1/17)
1886	-	1,700,000 " "	(A 3/703)
1887	-	1,565,000 " "	(A 3/703)
1888	-	3,521,556 " "	(A 3/703)
1889	-	2,560,000 " "	(A 1/17) (A 3/703)
1890	-	3,300,000 " "	(A 3/703)
1892	-	2,864,000	(A 1/17)
1893	-	2,985,485 " "	(A 6/164) (A 1/51)
1894	-	2,282,000 " "	(A 6/164)
1895	-	3,390,000 " "	(A 6/164)
1896	-	4,225,647 " "	(A 6/164) (A 7/169) (A 1/51)
1897	-	7,883,795 " "	(A 6/164) (A 7/169)
1898	-	9,685,088 " "	(A 6/164) (A 7/169)
1899	-	10,049,629 " "	(A 6/164) (A 7/169) (A 1/51)
1900	-	12,455,772 " "	(A 7/169)
1901	-	17,969,663 " "	(A 7/169)
1901	-	18,000,000	(A 16/259)
1902	-	19,400,000 (estimated)	(A 7/169)
1904	-	What Clark couldn't smelt at Butte he sent to Washoe Smelter	(A 1/69)

#### OTHER CITATIONS FOR BUTTE REDUCTION WORKS:

A 24, A 29, A 38/777, A 44, A 56, A 57.



CLARK'S COLUSA  
(later Boston and Montana Lower Works)

LOCATION:

Just south of Meaderville, west of the present (1953) highway (A 15/8).

CONSTRUCTED:

1884 - Built by W. A. Clark (A 16/262).

TERMINATED:

1893 - Closed by the most recent owners, the Boston & Montana Co.  
(A 16/262).

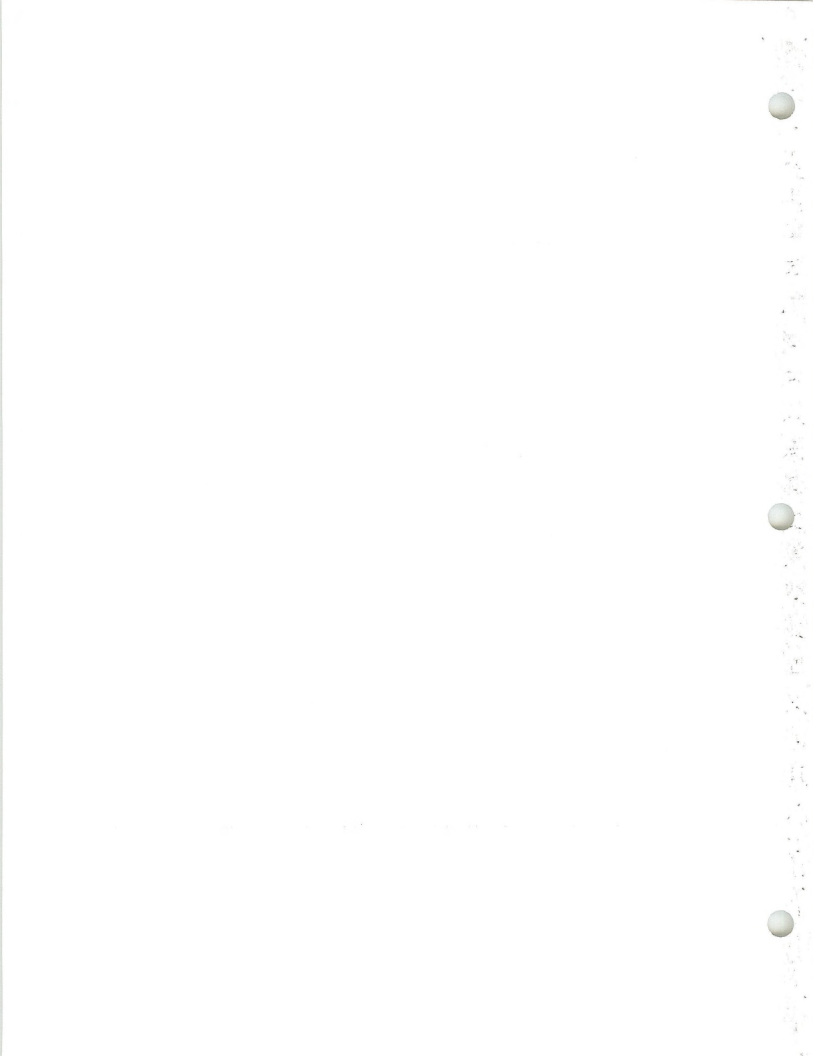
OWNERS:

1884 - W. A. Clark

1888-1893 - Boston & Montana Co. (formed their lower works).

PROCESS:

"These works were built in 1884 by W. A. Clark; were sold in 1888 to Boston and Montana Co., forming its Lower Works; and closed in 1893 in favor of the new plant at Great Falls. At this plant the first 2-hearth, mechanical O'Hara roasting-furnace was operated, 1885; the hearths were 50 by 7 ft. A second O'Hara furnace, erected in 1885, had hearths 70 by 7 ft., and treated 30 tons ore in 24 h. In 1891 ores were roasted in 3 O'Hara furnaces and one 10-ton Bruckner cylinder. The first smelting-furnace, a circular, water-jacket blast-furnace, 36 in. in diam. at the tuyeres and 9 ft. high, was replaced in 1885 by a larger furnace. In 1887, two 50-ton circular, water-jacket blast-furnaces were put in operation. In 1886, two reverberatory matting-furnaces were added to the plant, each treating 12 tons of charge in 24 hours."  
(A 16/262)



## EQUIPMENT:

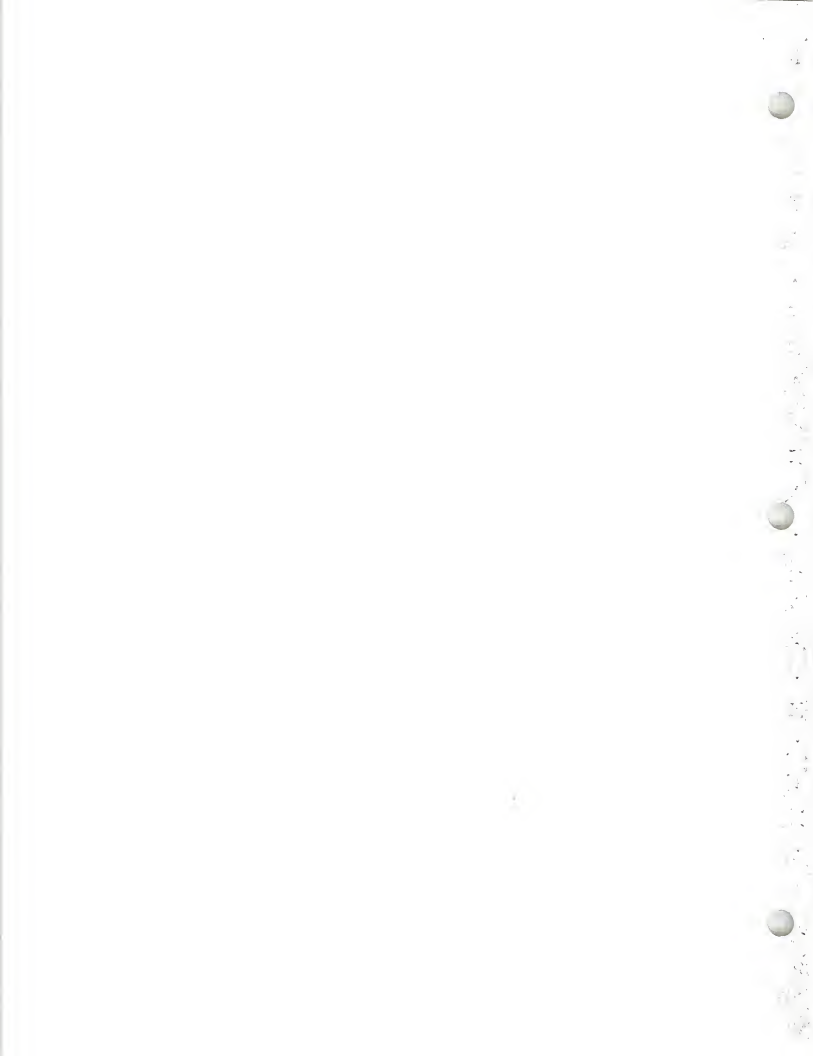
- 1884 - a) 1st smelting furnace--circular, water-jacketed blast furnace, 36" in diameter at tuyeres and 9' high.
- 1885 - a) 1st smelting furnace replaced by a larger furnace--no details on type or size.
  - b) 1st 2-hearth mechanical roasting furnace operated, hearths 50' x 7'.
  - c) 2nd O'Hara furnace erected, hearths 70' x 7'. (Treated 30 tons of ore in 24 hours.)
- 1886 - a) Two reverberatory matting-furnaces added to the plant, each treating 12 tons of charge in 24 hours.
- 1887 - a) Two 50 ton circular, water-jacket blast furnaces put into operation.
- 1891 - a) Ore roasted in 3 O'Hara furnaces and one 10-ton Bruckner cylinder.

## PRODUCTION STATISTICS:

1884	-	600,000 lbs. of copper	(A 3/703)
1885	-	10,000,000 " "	(A 3/703)
1886	-	7,000,000 " "	(A 3/703)
1887	-	7,100,000 " "	(A 3/703)
1888	-	7,000,000 " "	(A 3/703)
*1889	-	26,425,228 " "	(A 3/703, A 1/17)
*1890	-	26,822,804 " "	(A 3/703)
*1892	-	30,386,595 " "	(A 1/17)

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\*Production figures for these years are listed jointly with those of the Boston & Montana Company.





COLORADO SMELTING AND MINING COMPANY  
(later Trenton Mining & Dev. Co.)

LOCATION:

South side of Silver Bow Creek about 1 1/2 miles west of the present (1953) junction of Montana Street and the Creek (A 15/6).

CONSTRUCTED:

1878 - Ground occupied by smelter belonging to R. K. Williams. This smelter failed and was removed (A 15/6).

1879 - New smelter built by Henry Williams for the Boston & Colorado Smelting Co. (A 16/259).

At some point the Colorado Smelting & Mining Co. becomes the Trenton Mining & Dev. Co. Raymer says 1893 (A 1/13); Smith says it was a part of Trenton Mining Co. (A 15/9).

1894 - The smelter was almost destroyed by fire, but it was immediately rebuilt (A 15/9).

1895 - Henry Williams still the manager.

TERMINATED:

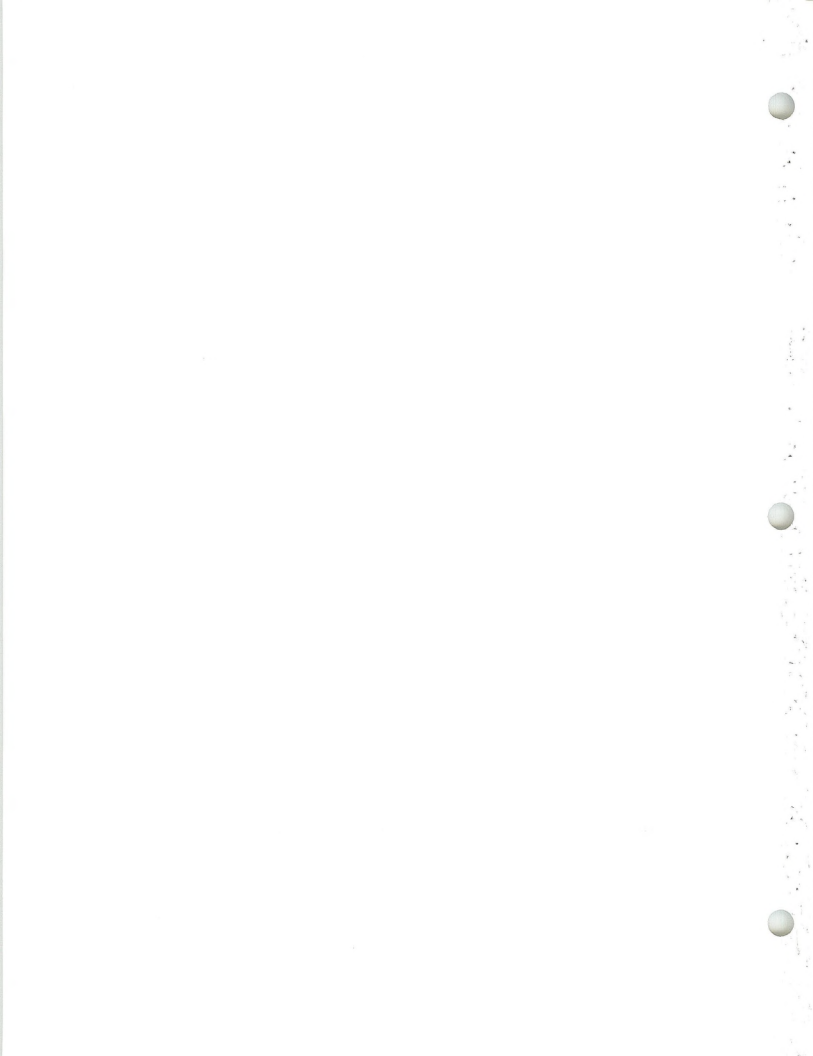
Possible 1904.

1910 - Trenton Mining & Dev. Co. taken over by Anaconda Co. (A 5/139; see also G 1/1).

Need further research to determine when the company became the Trenton Mining & Dev. Co.

OWNERS:

1879 - The smelter was started by the Boston & Colorado Smelting Co., largely at the instigation of W. A. Clark (A 15/5-6) under the name of the Colorado & Montana Smelting Co. (A 1/13). Officers were: President, N. P. Hill; Vice President, W. A. Clark; Secretary-Treasurer, H. R. Wolcott (A 15/6).



- 1883 - Corporation reorganized (according to Raymer) under the name of the Trenton Copper Co. (A 1/13).
- 1895 - Referred to as Colorado Company by Read.
- 1899 - Colorado Smelting & Mining Co. (Trenton Mining & Dev. Co.) taken over by Amalgamated (A 5/95). According to McNelis, Amalgamated accumulated large interests in the Colorado Smelting & Mining Co. (A 54/212).
- 1910 - According to ANACONDA, also Anaconda Company reports, Trenton Mining & Dev. Co. taken over by Anaconda in 1910 (G /1910).

#### PROCESS:

"This plant was started in 1879 by the late Henry Williams. The ore was roasted at first in the long-hearth hand reverberatory-furnace (hearth 12 by 50 ft.), and then smelted in a reverberatory matting-furnace (hearth 14 ft. 7 in. by 9 ft.), wood being used as fuel. The original smelting-furnaces treated 12 tons of ore in 24 h., producing matte assaying 60 per cent copper and from 700 to 800 oz. silver to the ton, which had to be hauled 200 miles to reach the railroad. In 1889 Bruckner cylinders came into use for roasting ores; followed in 1892 by the R. Pearce single-deck turret-furnace. In 1894 R. Pearce's first double-deck turret-furnace was added, and in 1901 the first six-deck turret-furnace of R. F. Pearce was put in operation. At present (summer, 1902), the roasting department has 4 single-deck turret-furnaces with 6-ft. hearths, 5 double-deck turret-furnaces (1 with a 6-ft. and 4 with a 7-ft. hearth), and one 6-deck turret-furnace with a 7-ft. hearth.

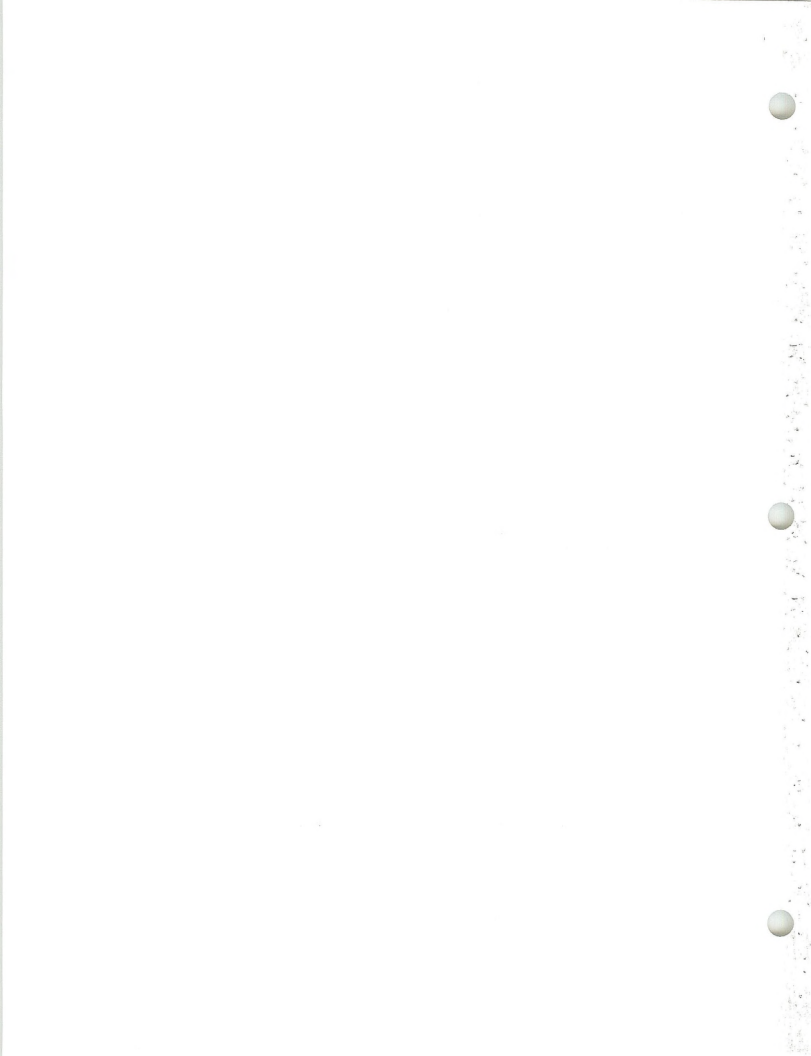
The hearths of the reverberatory matting-furnaces were made 21 by 12 ft. in 1889, increasing the capacity to 18 tons in 24 h. At present, there are 3 matting-reverberatories with hearths 47 by 20 ft. (the first of these larger furnaces having been erected in 1899). The matte containing copper, from 50 to 55 per cent; silver, 100 oz.; and gold, 1.5 oz. to the ton, is sold." (A 16/259-260)

#### EQUIPMENT:

- 1879 - a) Long-hearth hand reverberatory furnace, hearth 12' x 50'.
  - b) Reverberatory matting furnace, hearth 14'7" x 9' (A 16/259).
- 1879 - a) Blake jaw crusher
  - b) 2 Cornish rolls.



- c) 2 long-hearth hand-reverberatory roasting furnaces.
  - d) 2 reverberatory matting furnaces (12 ton per day capacity).
- 1882 - a) 50-ton capacity concentrator completed 1 mile west of smelter. Capacity later increased to 200 tons. Ran until 1893. (A 19).
- 1887 - 1888 - Existing equipment:
- a) 4 reverberatory furnaces
  - b) 6 calciners
  - c) 30 kilns for roasting, work 24 hr. shifts (C 1).
- 1889 - a) Bruckner cylinders used to roast ore
- b) Reverberatory matting furnaces--hearths made 21' x 12' (increased capacity to 18 tons in 24 hours) (A 16/259-260).
- 1892 - a) R. Pearce single-deck turret-furnace added.
- b) 200 ton capacity concentrator completed near smelter--later increased to 700 tons.
- 1894 - a) R. Pearce first double-deck turret-furnace added.
- 1895 - Plant contained:
- a) 4 reverberatory furnaces
  - b) 4 single-deck turret-furnaces
  - c) 3 double-deck turret-furnaces
- 1896 - See A 41 for description of concentrator and flow chart.
- 1899 - a) 1st large matting-reverberatory furnace erected, 20' x 150'. Capacity of 100-150 tons in 24 hours (A 2/342, A 2/343).
- 1901 - a) R. Pearce 6-deck turret-furnace put into operation.
- 1902 - a) 4 single-deck turret-furnaces with 6' hearths in operation.
- b) 5 double-deck turret-furnaces in operation (one with a 6' and four with 7' hearths)
  - c) one six-deck turret-furnace with 7' hearth in operation
  - d) 3 matting-reverberatories with 47' x 20' hearths in operation (A 16/259-260).



## PRODUCTION STATISTICS:

1885	-	1,200,000 lbs.	(A 1/17) (A 3/703)
1887	-	1,500,000 "	(A 3/703)
1888	-	1,488,000 "	(A 3/703)
1889	-	2,400,000 "	(A 14)
1889	-	2,954,000 "	(A 1/17)
1889	-	2,951,000 "	(A 3/703)
1890	-	2,320,000 "	(A 3/703)
1892	-	4,560,972 "	(A 1/17)
1893	-	6,703,488 "	(A 1/51) (A 6/164)
1894	-	fire 5,158,730	(A 6/164)
1895	-	7,750,000 "	(A 6/164)
1896	-	9,090,680 "	(A 1/51) (A 6/164) (A 7/169)
1897	-	8,911,578 "	(A 7/169) (A 6/164)
1898	-	7,657,938 "	(A 7/169) (A 6/164)
1899	-	9,572,155 "	(A 6/164) (A 7/169)
1900	-	11,453,940 "	(A 7/169)
1901	-	7,500,000 "	(A 16/259)
1901	-	7,465,260 (estimated)	(A 7/169)
1902	-	10,000,000 (estimated)	(A 7/169)
1907	-	6,794,475 "	(A 8)
1908	-	6,229,940 "	(A 8)
1909	-	8,547,378 "	(A 8)

## OTHER CITATIONS FOR COLORADO SMELTING &amp; MINING CO.:

A 19, A 22, A 41, A 45, H 1.





## ALICE MINE AND MILL

## LOCATION:

Walkerville (A 19)

## CONSTRUCTED:

1877 - 20 stamp Alice Mill constructed (A 15/3).

1880 - 60 stamp mill added (A 15/4).

## TERMINATED:

1892 (June) - Shut down permanently (A 19).

## OWNERS:

1877 - Walker Brothers of Salt Lake City (A 1/10).

1878 - Alice Gold Mining Co. Incorporated (A 1/10).

1910 - Alice Gold & Silver Mining Co. sold out to Anaconda Co. (G 1/1).

## PROCESS:

See pages 2-5 (A 14) for description of milling and smelting silver ore.

## EQUIPMENT:

1877 - a) 20 stamp mill built, each stamp weighing 1000 lbs.  
Stamp mill built for dry crushing of oxidized and free milling ores as there was not enough water available for wet crushing.



1880 - a) 60 stamp mill added.

b) 2 White-Howell roasters added.

c) 2 revolving dryers constructed so that sulphide ore could be treated with chlorodizing roasting.



COLUSA SMELTER OF MONTANA COPPER COMPANY  
(later Boston & Montana)

LOCATION:

According to a map from the Montana Bureau of Mines and Geology (reprint #2, plate 2), the smelter was located northeast of Meaderville (A 15).

CONSTRUCTED:

1880 - Smelter built by Alfred Wartenweiler for the Montana Copper Co. (A 15/6; A 16/260).

TERMINATED:

1893 - Closed by the most recent owners, the Boston & Montana Co. (A 16/260).

OWNERS:

- 1880 - The Montana Copper Company, managed by Charles Meader. Alfred Wartenweiler was Superintendent (A 15/6).
- 1888 - Sold to the Boston & Montana Company and formed the Boston & Montana's Upper Works (A 16/260). When the Boston & Montana Co. opened their Great Falls plant in 1893, they closed the Colusa Smelter (A 16/260).

PROCESS:

- a) 1879-1880 - Dry crushing was accomplished by an 8" x 10" Blake crusher. From there the ore passed over a shaker to a pair of 10" x 20" rolls. It then moved on over revolving trommels with 1/2" mesh screens. The oversize ore went into a set of 10" x 16" rolls. No water was used until the material went to the jigs (A 12/174).
- b) "This smelter was started in 1880 by A. Wartenweiler, with 4 long hand-reverberatory roasters (hearths 60 ft. by 11 ft. 6 in.), and 2



hand-reverberatory matting-furnaces (hearths 15 ft. 9 in. by 10 ft.). Smelting was begun in 1881; a reverberatory matting-furnace treated in 24 h. 12 tons of raw and roasted ores, producing 65-per cent copper-matte, with a consumption of 10 cords of wood. Lump-ore was at first heap-roasted, but, on account of the smoke-nuisance, the heaps were replaced in 1882 by stalls. In 1884 there were in operation, besides the stalls, 12 long-hearth hand-reverberatory-roasting, 6 reverberatory-matting, and 1 blast-furnace. The latter, 3 ft. by 4 ft. 6 in. at the tuyeres and 10 ft. high, was run with charcoal. The works were sold in 1888 to the Boston and Montana Con. Copper & Silver Min. Co., and formed the so-called Upper Works. They were closed down in 1893, when the new Great Falls establishment of the company made them superfluous." (A 16/260)

#### EQUIPMENT:

1881 - Smelting began

- a) 4 long hand-reverberatory roasters, hearths 60' x 11'6".
- b) 2 reverberatory matting furnaces, hearths 15'9" x 10'.
- c) Lump-ore heap-roasters.

1882 - a) Heaps replaced with stalls.

1884 - The following equipment was in operation:

- a) 12 long-hearth hand reverberatory-roasting furnaces.
- b) 6 reverberatory matting-furnaces
- c) 1 blast furnace 3' x 4'6" at the tuyeres and 10' high

#### PRODUCTION STATISTICS:

No separate production statistics are listed in present research sources for this smelter.

#### OTHER CITATIONS FOR COLUSA SMELTER:

H 1.





## BOSTON AND MONTANA

## LOCATION:

Operated Colusa Smelter, area of Meaderville, and Clark's Colusa Smelter, area of Meaderville, until Great Falls plant was built in 1893 (A 15/8, A 15/map).

## CONSTRUCTED:

1880 - Colusa Smelter (upper works) built by Alfred Wartenweiler for Montana Copper Co. - purchased by Boston and Montana in 1888 (A 16/260).

1884 - Clark's Colusa (lower works) built by W. A. Clark - taken over by Boston and Montana in 1888 (A 16/262).

## TERMINATED:

1893 - Closed when Great Falls plant went into operation (A 16/260 & 262).

## OWNERS:

1880 - Upper works owned by Montana Copper Co. (A 15/6

1884 - Lower works belonged to W. A. Clark (A 16/262).

1888 - Boston & Montana Co. purchased both smelters.

1899 - Anaconda Co. (Amal.) accumulated large interests in the Boston Coalition Cos. of Boston & Montana and Butte & Boston (A 54/212).  
Need further research to determine if these two smelters were ever reopened after 1902.

1910 - Anaconda Co. bought property and assets of the Boston & Montana and Butte & Boston companies.

## PROCESS:

See operation as listed under Clark's Colusa and Colusa smelters.



## EQUIPMENT:

See equipment lists for Clark's Colusa and Colusa smelters. Also, after 1895, one might need to include the equipment of the Butte & Boston Co. See special concerns, below.

## SPECIAL CONCERNS:

Production figures are available for the Boston & Montana Company from 1884 to 1887 (A 3/703), before the company purchased Clark's Colusa or the Colusa Smelter. We need further research to determine where the Boston & Montana Co. was smelting prior to 1888.

Also, there is evidence that the Boston & Montana consolidated with the Butte & Boston Co. in 1895, and that the Butte & Boston continued to operate its Butte smelter after the consolidation. Sarah McNelis, in COPPER KING AT WAR (1968), p. 212, indicates that the Anaconda Co. (Amalgamated) bought large interests in the "Boston coalition companies of the Butte & Boston and Boston & Montana firms" in 1899. When production figures are listed jointly with these two firms, we are unable, without further research, to determine how much of the ore was smelted in Great Falls and how much in Butte. Also, although the ENGINEERING AND MINING JOURNAL lists the Butte & Boston and Boston & Montana jointly and separately from 1896 to 1902, the narrative which follows refers to the Boston and Montana Consolidated and the Butte and Boston Copper & Silver Mining Company.

## PRODUCTION FIGURES:

1884	-	6,600,000 lbs.	(A 3/703)
1885	-	7,500,000 "	(A 3/703)
1886	-	2,000,000 "	(A 3/703)
1887	-	1,500,000 "	(A 3/703)
1888	-	18,278,667 + 700,000 for Clark's Colusa	(A 3/703)
1889	-	56,425,228 (figures for Clark's Colusa and Boston & Montana listed together)	(A 3/703)
1890	-	26,822,804 (listed jointly with Clark's Colusa)	(A 3/703)

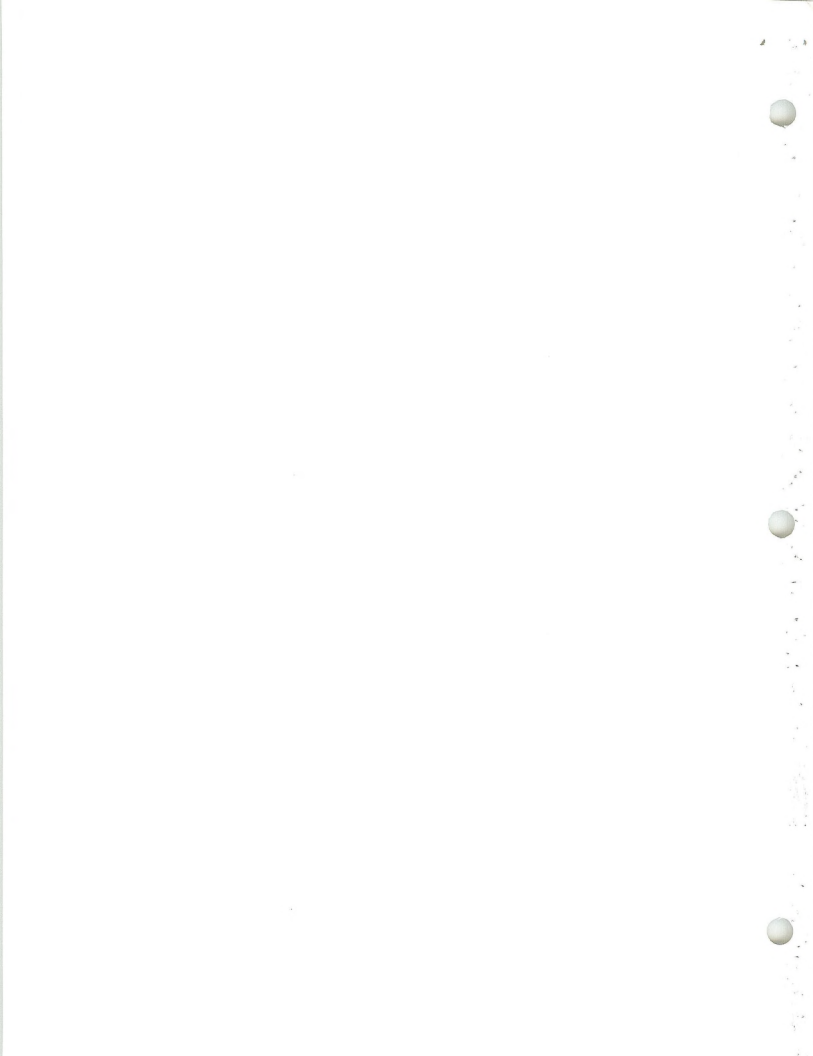


1893	- 31,800,000 lbs. .	(A 6/164)
	(From 1893 on, if the production figures are listed separately from those of the Butte & Boston, we can assume that ore was processed in Great Falls.)	
1894	- 57,937,633 lbs. (listed jointly with Butte & Boston)	(A 6/164)
1895	- 60,746,000 (listed jointly with Butte & Boston)	(A 6/164)
1896	- 60,250,000 (listed separately)	(A 6/164)
1897	- 60,000,000 (listed separately)	(A 6/164)
1898	- 62,000,000 (listed separately)	(A 6/164)
1899	- 79,000,000 (listed jointly with Butte & Boston)	(A 6/164)
1900	- 66,200,000 (listed separately)	A 7/169)
1901	- 58,028,746 (estimated jointly with Butte & Boston)	(A 7/169)
1902	- 75,000,000 (estimated separately)	(A 7/169)

We need further research to determine if Butte & Boston and Boston & Montana consolidated, and if and when the companies broke the merger after 1899.

#### OTHER CITATIONS FOR BOSTON AND MONTANA:

A 10, A 22, A 23, A 28, H 1



# PARROT SILVER AND COPPER COMPANY / PARROT SMELTER

## LOCATION:

2 1/2 miles east of present (1953) Northern Pacific depot just south of tracks, place now occupied by City incinerator and shops (A 15/6).

## CONSTRUCTED:

- 1866 - 1st crude smelter erected (A 1/11, A 15/2). After several attempts the furnace was declared a failure and soon abandoned. The original furnace was constructed on what is now Quartz St., between Main and Alaska Streets (A 15/2).
- 1868 - New furnace constructed just below Parrot mine. Shut down before year was out (A 15/2).
- 1881 - Parrot smelter opened (A 16/260).
- 1884 - 1st converting plant in Butte erected and was used from 1884-1890. 1st American copper smelter to use Bessemer process (A 15/9, A 12/176).
- 1890 - Plant was remodeled and 1884 converters were replaced with interchangeable converters operated by hydraulic power instead of belt transmission (A 12/176).

## TERMINATED:

- 1910 - Anaconda Co. (Amal.) purchased Parrot Silver & Copper Co.

## OWNERS:

- 1866 - Dennis O'Leary, Joseph Ramsdell, William Parks, Theodore C. Porter (A 1/11, A 15/2).
- 1868 - O'Leary, Ramsdell, Newkirk (A 15/2).
- 1880 - Parrot Silver & Copper Co. formed by Achille Migron, Franklin Farrell, Sanwel Hauser, Anton Holter (A 1/11).
- 1895 - Corporation officers:





Franklin Farrell of Ansonia, Conn., President; J. E. Gaylord, Butte, Secretary and General Manager; Ben Tibbey, Supervisor of Mines; Herman Keller, Supervisor of Smelter and Metallurgist.

1899 - Anaconda Co. (Amal.) acquired large interests in the Parrot Silver & Copper Co. (A 54/212).

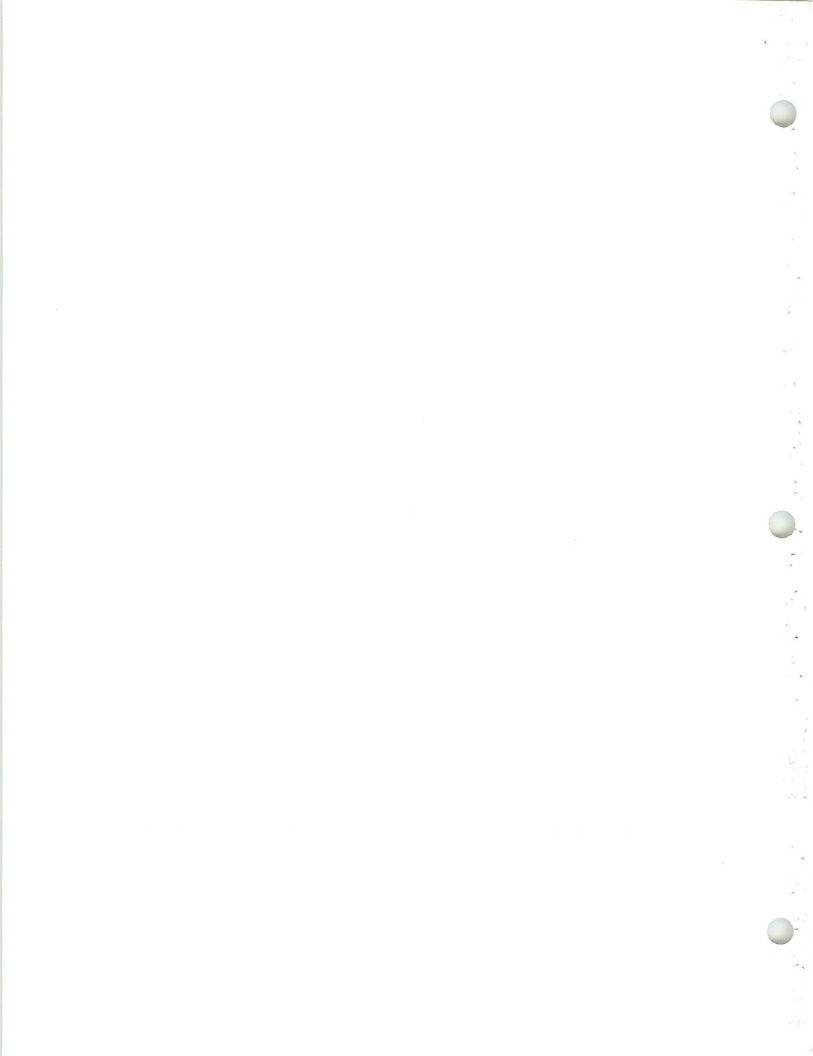
1910 - Anaconda Co. purchased property and assets of company.

#### PROCESS:

"The works were started in July, 1881. Ore was at first roasted in 11 long hand-reverberatories (hearths 60 by 14 ft.) and smelted in 6 matting-reverberatories (hearths 14 ft. by 11 ft. 6 in.). The smelting-charge weighed from 2 to 3 tons; 10 tons were put through a furnace in 24 h. The matte (60 to 67 per cent copper and 40 to 45 oz. silver per ton) was at first brought forward to blister-copper, but this was soon given up on account of the excessive cost, and the fact that matte was more easily marketed than blister-copper. Shortly after starting of works, a stall, 40 ft. deep and 9 ft. high, was built by J. T. Reese to roast lump-ore. It proved a failure and was replaced by A. J. Schumacher with open stalls, 8 ft. deep, 6 ft. high and 6 ft. wide. In 1891 there were in operation 120 stalls. The hand-reverberatory roasting-furnaces were supplemented in 1889 by 2 small Spence mechanical shelf-roasting furnaces, each treating 5 tons of concentrates in 24 h., reducing sulphur to from 6 to 7 per cent; these were replaced in 1892 by a round, and in 1893 by 2 oblong Keller-Gaylord-Cole mechanical shelf-burners.

A Roberts 4-hearth mechanical reverberatory-roaster, made by the Western Iron-Works of Butte, and similar to the Wethey furnace, was put in operation in 1897. The hearths of the matting-reverberatories were enlarged in 1887 to 16 ft. by 12 ft. 6 in. For lack of space they never reached the large sizes of the other furnaces at Butte. The largest furnace, built in 1895, had a hearth of 22 ft. by 16 ft. In 1884 a Herreshoff 48-in. water-jacket blast-furnace was erected by E. D. Peters; in 1885 a 3- by 6-ft. blast-furnace, with cast-iron water-jackets, was added, but was soon replaced by A. J. Schumacher with a 3- by 8-ft. furnace having steel jackets. In 1884 the converting of copper-matte was begun under the general direction of the inventor of the process, Pierre Manhès. The practice was to melt 40- to 50-per cent copper-matte in a cupola-furnace, tap it into converter, blow to white metal and pour, then melt the white metal in the cupola and blow it to blister-copper in the converter. In 1885 A. J. Schumacher succeeded in making metallic copper from 40- to 50-per cent matte in one operation of two consecutive stages, and thus laid the foundation of the modern practice of converting.

When the works were closed down, August 20, 1899, the roasting department contained 2 Keller-Cole-Gaylord furnaces, each having a capacity of 50 tons ore, and 1 O'Hara furnace, treating 50 tons in 24 h.



Smelting was carried on in 3 undergrate blast reverberatory furnaces with hearths 20 by 12 ft., treating altogether 135 tons of ore in 24 h., and in 2 blast-furnaces, 44 in. by 96 in. at the tuyeres, each putting through 120 tons of charge daily. The converting department had 6 up-right converters, 5 ft. in diameter and 8 ft. 6 in. in total height." (A 16/260-262)

#### EQUIPMENT:

- 1881 - a) 11 long hand-reverberatories, hearths 60' x 14'.
  - b) 6 matting reverberatories, hearths 14' x 11'6".
  - c) Stall, 40' deep, 9' high, unsuccessful.
  - d) Open stalls, 8' deep, 6' high, 6' wide.
- 1882 - a) 50-ton concentrator erected (A 19).
- 1883 - a) Concentrator increased to 350 tons (A 19).
- 1884 - a) Herreshoff 48" water-jacket blast furnace erected. Began process of converting copper matter.
- 1885 - a) 3' x 6' blast furnace with cast-iron water-jackets added.
  - b) Soon replaced with 3' x 8' furnace with steel jackets.
- 1886 - a) Concentrating plant capable of handling 240 tons of ore a day (2nd largest producer in district) (A 15/9).
- 1887 - a) Hearths of matting reverberatories enlarged to 16' x 12'6".
  - b) Equipment in use to date according to BUTTE HOLIDAY MINER.
- 1889 - a) Hand-reverberatory roasting furnaces supplemented by two small Spence mechanical shelf-roasting furnaces.
- 1891 - a) 120 stalls in operation.
- 1892 - a) Spence furnaces replaced by a round Keller-Gaylord-Cole mechanical shelf-burner.
- 1893 - a) Round Keller-Gaylord-Cole mechanical shelf-burner replaced by two oblong Keller-Gaylord-Cole mechanical shelf-burners.
- 1896 - See flow chart of Parrot concentrator (A 43).



1897 - a) Roberts four-hearth mechanical reverberatory-roaster (similar to Wethey furnace) put into operation.

b) Converter size:  
 outside height, ft. 8.5  
 outside diameter, ft. 5  
 blast pressure, pounds per sq. inch 11  
 initial charge, pounds 2,500  
 maximum charge, pounds 9,000  
 blows per 24 hours 16  
 weight of shell and lining, pounds 16,000  
 number of tuyeres 16

1899 - Smelter closed down (temporarily?) consisted of:

- a) 2 Keller-Cole-Gaylord furnaces (capacity, 50 tons of ore)
- b) 1 O'Hara furnace (treating 50 tons in 24 hours)
- c) 2 undergrate blast reverberatory furnaces with hearths 20' x 12' (135 tons of ore treated in 24 hours by all three reverberatories).
- d) 2 blast furnaces, 44 inches by 96 inches at the tuyeres. (240 tons of charge treated daily by furnaces together)
- e) 6 upright converters, 5' in diameter and 8'6" in total height.

#### PRODUCTION STATISTICS:

1883	-	6,600,000 lbs. of copper	(A 1/11)
1884	-	9,300,000 " "	(A 3/703)
1885	-	9,809,000 " "	(A 1/17)
1886	-	10,000,000 " "	(A 3/703)
1887	-	10,000,000 " "	(A 3/703)
1888	-	10,750,000 " "	(A 3/703)
1889	-	9,500,000 " "	(A 1/17) (A 3/703)
1890	-	9,000,000 " "	(A 3/703)
1892	-	12,438,782 " "	(A 1/17) (A 6/164)
1893	-	7,791,167 " "	(A 1/51)
1894	-	7,469,908 " "	(A 6/164)
1895	-	7,257,000 " "	(A 6/164)
1896	-	8,045,648	(A 6/164) (A 7/169)
1897	-	14,824,487	(A 6/164) (A 7/169) (A 1/51)



1898	-	12,444,828 lbs. of copper	(A 6/164) (A 7/169)
1899	-	10,625,696 " "	(A 6/164) (A 7/169) (A 1/51)
1900	-	production figures included under "Other Mines"--no way of knowing how much produced by Parrot	(A 7/169)
1901	-	10,167,850 (estimated)	(A 7/169)
1902	-	10,000,000 (estimated)	(A 7/169)

## OTHER CITATIONS FOR PARROT SMELTER:

A 19. A 21, A 22, A 43, A 49, H 1.





PARROT SMELTER  
Miscellaneous Information

Results of Bessemerizing Copper Matte, Reducing Time 333 1/2 days (H 5/551-552)

	<u>Weight in Lbs.</u>	<u>Copper Per Cent</u>	<u>Silver Ounces Per Ton</u>	<u>Silver Per Cent</u>
Coke used for remelting matte	3,814,248	-----	-----	-----
Matte charged		55.4	61.9	0.213
Blister copper produced	18,622,700	99.1	114.44	0.393
Chips for resmelting	1,138,480	7.5	9.00	0.031
Flue-dust from cupola	453,610	33.9	33.0	0.113
Flue-dust from converters	154,500	64.9	65.7	0.225
Converter slag	-----	1.16	0.60	0.002
Cupola slag		0.56	0.78	0.0027

Results of Bessemerizing Copper Matte, Running Time 31 days (H 5/551-552)

	<u>Weight in Lbs.</u>	<u>Copper Per Cent</u>	<u>Silver Ounces Per Ton</u>	<u>Silver Per Cent</u>
Coke for remelting matte	305,234	-----	-----	-----
Quartz for lining converters	400,000	-----	-----	-----
Clay for lining converters	120,000	-----	-----	-----
Matte charged		55.9	59.0	0.200
Blister copper produced	2,075,609	99.2	103.84	0.356



	Weight in Lbs.	Copper Per Cent	Silver Ounces Per Ton	Silver Per Cent
Chips for resmelting (75.4% SiO <sub>2</sub> )	53,980	10.0	9.0	0.031
Flue dust from cupola	33,610	38.8	42.5	0.146
Flue dust from converters	3,810	54.8	55.0	0.190
Converter slag*	-----	1.1	0.4	0.0014
Cupola slag	-----	0.5	0.6	0.002
*Reduced by retreatment to	-----	0.3	0.3	0.001



## DOMESTIC MANGANESE AND DEVELOPMENT COMPANY

LOCATION: Junction of Montana Street and Burlington Northern Railroad tracks.

CONSTRUCTED: Operations began March 15, 1928 (K 1/20).

TERMINATED: Unknown

OWNERS: Domestic Manganese & Development Corporation, John H. Cole, President (K 1/20).

PROCESS: The plant produced "beneficiate manganese ore." The process was described roughly as follows:

"This company has been organized to treat the manganese ores of Butte, and by calcining and nodulizing obtain a very perfect and high grade furnace product. The crude ore of this camp assays about 36% manganese and 4% silica. By concentrating 1 1/2 tons into one a product of about 57% manganese, and which contains neither dust nor moisture, is achieved. . . . The plant has a capacity to treat 500 tons crude ore per day. The fact that the product of the plant contains no dust is of much interest, as blast furnaces experience a dust loss as high as 10% in the use of natural manganese ore.

The manganese ores to be calcined and nodulized at the plant of the Domestic Manganese & Development Co. will for some months at least come from the Emma mine in Butte, an Anaconda property." (K 2/1, 4).

Another source described the process as sintering (K 1/20).

EQUIPMENT: Machinery for the plant was provided by the Allis-Chalmers Manufacturing Company.

1929 - Two kilns in operation.

## PRODUCTION STATISTICS:

1928 - 12,000 tons of sintered manganese ore, approximately 57% manganese (K 1/20).

1929 - 43,000 tons anticipated production (K 1/21).



## ROCKY MOUNTAIN PHOSPHATES, INC.

LOCATION: Montana Street at junction of Burlington Northern tracks, formerly mill of Domestic Manganese Co.

CONSTRUCTION: Sublet plant from Anaconda Co. in 1959. Occupied as of July 1, 1960.

TERMINATION: Operations halted during daytime hours by temporary court injunction of May 2, 1963. Rocky Mountain Phosphates returned the plant to Anaconda Co. on Jan. 3, 1964.

OWNERS: Plant owned by Domestic Manganese and Development Co.

PROCESS: Phosphorite rock was nodulized and charged in a furnace to produce tricalcium phosphate animal feed supplement with a minimum analysis of 42 percent  $P_2O_5$ . Emissions included flourine, flouride particles, and sulphur dioxide. (P 1/120 and P 4; Letter 12/19/61 by B. Rhodes).

## EQUIPMENT:

250 foot stack for "nodulizing building"  
2 rotary kilns  
2 coolers  
Crude and fine ore bins  
Change house or "dry"  
2 elevators  
Dust chambers  
(CC 8)

## PRODUCTION STATISTICS:

Butte plant capacity 75 tons per day from total "feed capacity" of 3,600 tons per month of phosphorite. (P 1/130).





## BERKELEY PIT

LOCATION: Northeast section of Butte, on southeast slope of Butte Hill, and expanding.

CONSTRUCTION: 1956 was the first year of operation (M 1/3).

TERMINATION: Currently operating.

OWNERS: Anaconda Company

PROCESS: The Berkeley Pit is a strip-mine operation, removing overburden to reach low-grade copper ores. Blasting in the pit involved drilling blastholes. Drill cuttings were captured with canvas dust aprons. The explosives were diesel oil-saturated ammonium nitrate (M 1/24).

EQUIPMENT: In 1959, the company used electric-powered shovels (five Bucyrus-Erie 150-B's and one Bucyrus-Erie 71-B) and 43 trucks. Eighteen of those trucks were 24-yard end-dump Mack trucks with 34 ton capacity. Twenty-five were 34-ton Euclid models. All models were diesel-powered (M 1/27). In addition to the shovels and trucks, the company operated a 3- by 4-foot jaw crusher on a temporary basis. It was replaced by a 5- by 7-foot jaw crusher on the pit's southern rim (M 1/32).

## PRODUCTION STATISTICS:

1956 - 14,000 tons of ore per day

1957 - averaged 17,500 tons per day by mid-summer

1958 - April daily average 26,000 tons (M 1/3).



NOTE: Undoubtedly, much additional information concerning the Berkeley Pit and associated operations is available in secondary literature, company records, and the files of the Air Quality Bureau. Since it is a current operation, researchers sought only information indicative of its earlier operations.



## TIMBER BUTTE MILLING COMPANY

LOCATION: Northern slope of Timber Butte at foot of Montana Street.

CONSTRUCTION: Operations began in June, 1914 (A 13/922).

TERMINATION: Dismantled in spring, 1948, though closed years before (A 15/16).

OWNERS: Timber Butte Milling Co., W. A. Clark, Jr., President and General Manager.

PROCESS: The plant was essentially a concentrator for zinc and copper ores. The concentration was obtained through a gravity and flotation process (A 17/16). For a detailed discussion of plant operations see A 13/910-931 and A 35/no pagination.

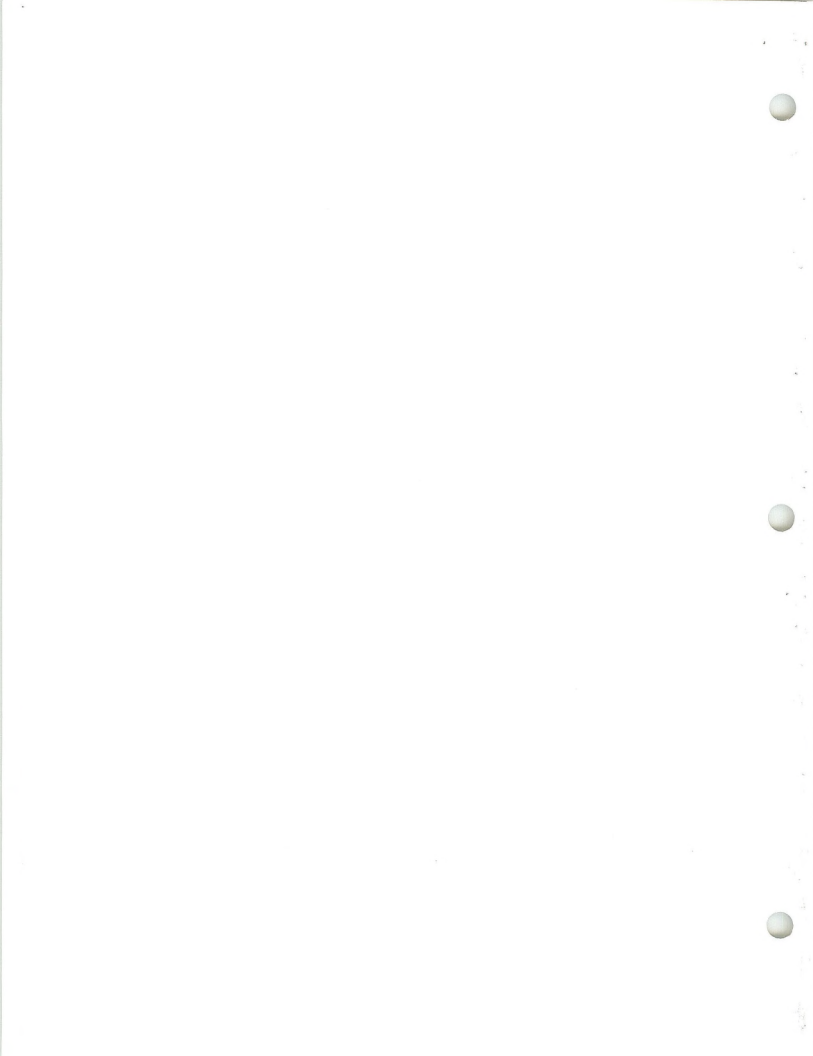
EQUIPMENT: For a list of 72 items of equipment at the mill in 1919, see A 35.

## PRODUCTION STATISTICS:

Capacity in 1919 was 2,000 tons of ore per day. As originally constructed, it could treat 300 tons per day (A 17/15).

Daily output in 1919 was 700 tons of zinc ore and 1,300 tons of copper tailings (A 31/23).

Total output for 1918 was 190,000 tons of crude zinc ore and 387,000 tons of copper tailings (A 31/32).



## 2. *Public Utility Plants*

### ALICE MINE-POWER PLANT

Public utility plants in Butte, dating back to 1880, generated pollution in addition to power and fuel. The first such plant was that of C. C. Ruthrauff (T 1/24-B). Utilizing a 20-horsepower steam engine, he supplied electric power to the Alice Mine in 1880. It is unknown whether that engine was fueled with wood, coke, or coal, as no further information pertaining to that operation was recovered in this preliminary investigation.

### CLARK POWER PLANT

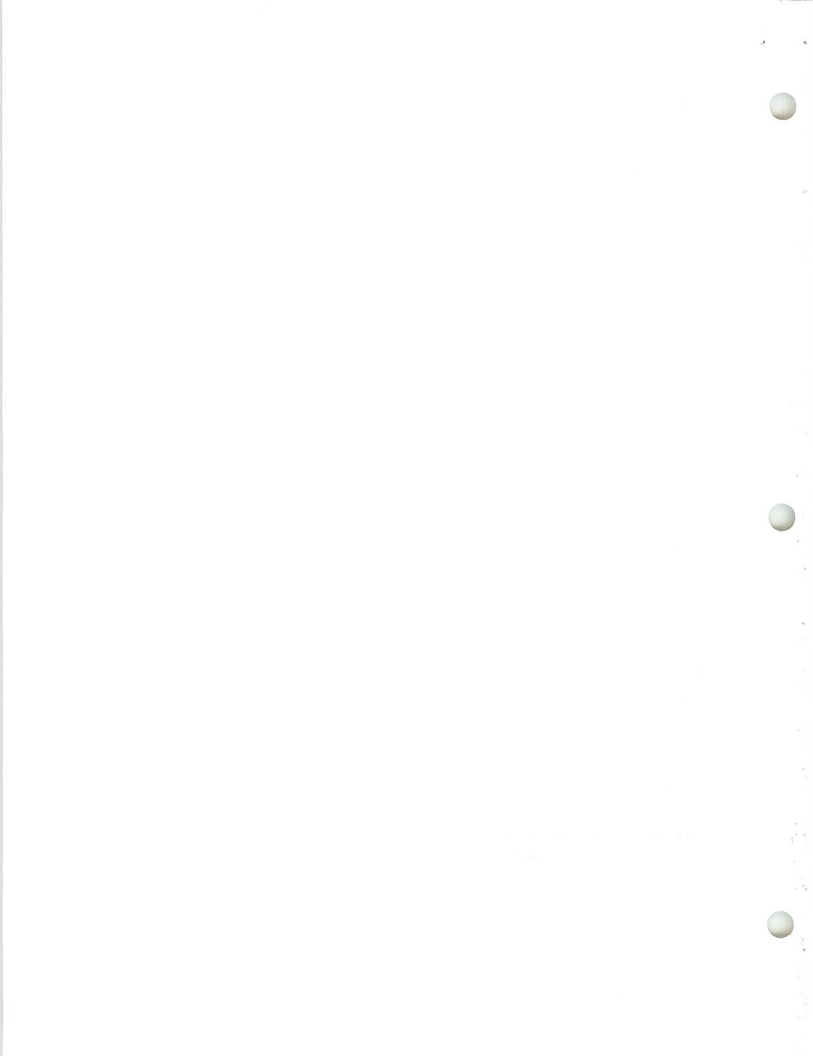
In 1882-83, W. A. Clark and a group of co-investors built Butte's first significant power production plant. On East Mercury Street, between Arizona and Wyoming, they constructed a generating station powered by steam. The plant was still in operation in 1890, but no termination date was found. Again, the fuel supply is unknown, though it probably was cordwood or coal (T 1/24-B). Four boilers, two each of 60 horsepower and two of 50 horsepower rating, powered the engines which were belted directly to the dynamos (S 2/47).

### SILVER BOW ELECTRIC LIGHT COMPANY

A third power plant in Butte was that of the Silver Bow Electric Light Company. Organized in 1889, the company used four boilers to operate electrical generating equipment (S 2/47-48). No further documentation of the operation has been found.

### BUTTE GAS, LIGHT AND COKE COMPANY (Sometimes referred to as Butte Gas, Light and Fuel Company)

LOCATION: Corner of Second Street and Maryland Avenue, Butte.  
 CONSTRUCTED: 1883-1884  
 TERMINATED: Sometime after 1918.  
 OWNERS: Owned and operated as department of Montana Power Company during later years.





PROCESS: The following description of Butte Gas, Light, and Coke Company's plant operations is from a 1918 report by Professor H. B. Pulsifer of the Montana School of Mines.

"From the two large gas holders the company serves a large portion of the city of Butte thru mains from 12" diameter down to 2" diameter. Of these main lines the company now has close to 30 miles in service. In addition the company has another 30 miles of small service lines distributing to the individual consumers."  
(Z 1/3)

#### "The Gas Retorts

Beginning some 36 years ago when the first bench of five retorts was installed a section has been added at intervals until the present total of five benches of six retorts, each. This number has now been in service for a few years. Another bench is under construction and would have been finished before now except for the War whose necessities denied the structural steel required.

The charge of coal for each retort is 400 lbs. A retort is fired each 6 hours and the plant is so divided that some retorts are drawn each hour to make a steady gas current to the holders.

Figure 7 shows the men charging the retorts immediately after the draw. As soon as the coal is thrown in it breaks into flames so that the door is closed and luted at once.

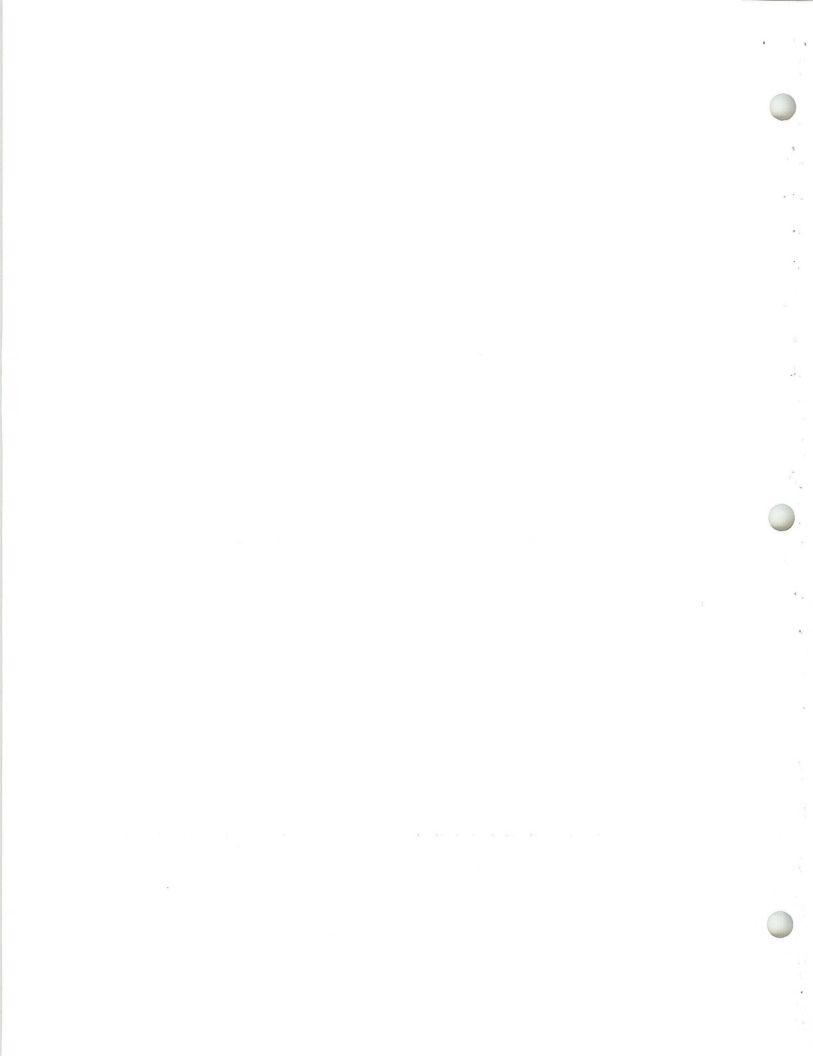
The coke is at once quenched with buckets of water and then is either pushed thru to the grate below a bench or wheeled out to the stock pile in the yard. Almost 25% of the coke made has to be used as fuel to maintain the distillation temperature of the coal.

The whole plant requires some 25 tons of coal daily. Sixty per cent of the weight of the coal results in coke produced. The retorts need no other cleaning than just raking the coke out at the end of the 6-hour period. After a long period of months, say a year, enough deposited gas coke has precipitated on the roof of the retort to warrant scraping off. This will be a layer of varying thickness, at most about an inch, which is of course very pure carbon.

#### The Coal Gas

The gas and tarry vapors pass up thru the 8-inch main to the horizontal trough across the top of the benches. A water seal has a depth of 2.6 inches and so easily prevents back draft and explosions. Each pound of coal should give 5 cu. ft. of gas.

In an adjoining room the gas is sucked thru either a rotary blower or steam injector and pushed into the purification house one



step further away. Figure 9 gives a glimpse of the first three of these tall coolers and cleaners. At the left is an air-cooled affair, then come 3 water-cooled tanks of which only two are in the picture. The interiors are filled with tubes and baffle plates.

From these 4 vertical coolers and cleaners the gas goes to a small machine where it is violently sprayed with water to remove the last of the tar. The gas then goes thru the flat boxes also shown in Figure 9, where the last of the tar and any hydrogen sulfid is removed. These two flat steel boxes are filled with wood shavings, fine iron turnings and sal ammoniac.

Periodically one of the boxes has its cover lifted--it is made gas tight simply by means of a water seal--and the contents are spread out to air in the roomy space of the first or ground floor directly below. The ammonium silfid diffuses away and then fresh material will be added as it is replaced in the purifier.

From this last purifier the gas goes to the little office and meter building where it passes thru a Venturi meter and then to the holders. A typical meter chart covering 24 hours will be seen on the next sheet. The larger gas holder has a capacity of 315,000 cu. ft. and the smaller one a capacity of 110,000 cu. ft.

#### Gas Analysis of March 17, 1914:

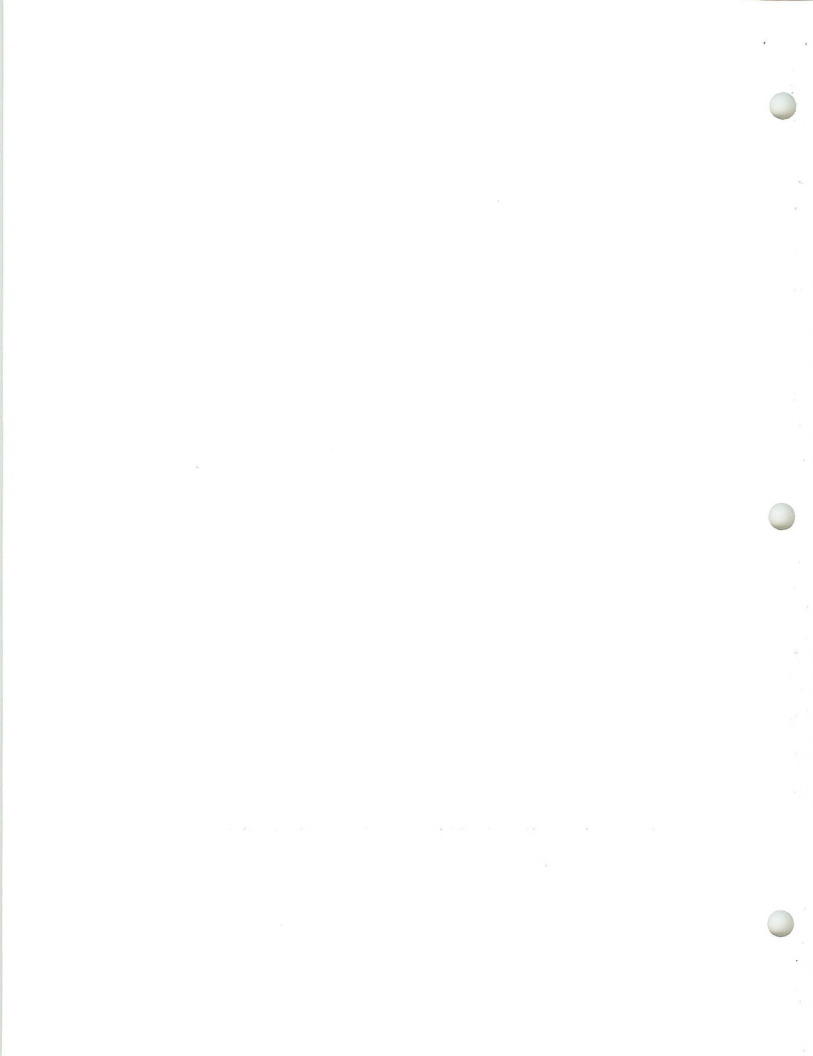
CO <sub>2</sub> .....	3.20%	
O <sub>2</sub> .....	2.20	B. t. u.
CO.....	12.60	44
H <sub>2</sub> .....	45.60	159
Hydrocarbons.....	31.10	331
N <sub>2</sub> .....	5.30	534

Total S, 7.52 grains per 100  
cu. ft.; H<sub>2</sub>S, trace."

(Z 1/6, 11)

#### EQUIPMENT:

- 1890 - Twenty retorts arranged in four benches of five retorts each; one gasometer, storage capacity 35,000 cubic feet of gas.
- 1890 - Construction begun on new storage tank with a capacity of 110,000 cubic feet of gas.
- 1918 - Equipment consisted of 2 gas storage tanks, 30 retorts, tank coolers and cleaners, "flat shaving" purifiers,



## PRODUCTION STATISTICS:

1890 - Approximately 1,500,000 cubic feet of gas per month with one gasometer holding 35,000 cubic feet of gas (S 2/47).

1918-1925 - 25 tons of coal used daily--one pound producing approximately 5 cubic feet of gas (A 1/6).

Insufficient data for other years.

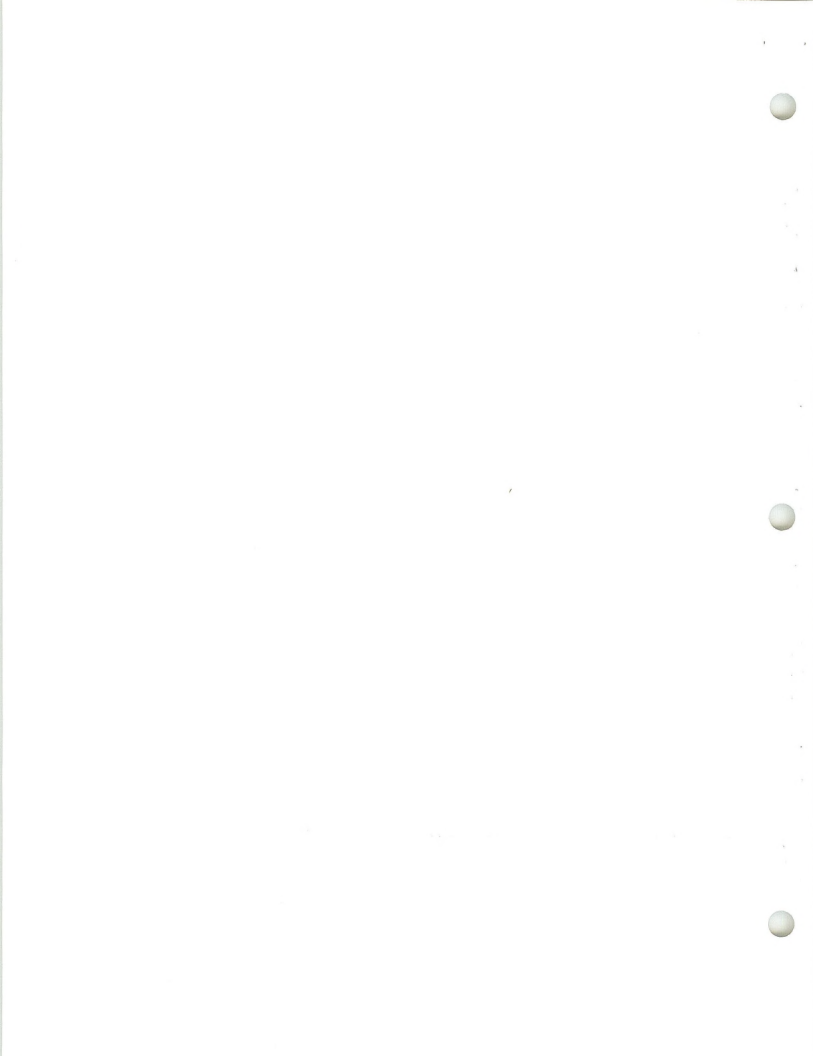
### 3. *Timber Products Industry*

Cordwood fueled much of Butte's industry and heated many homes during the latter portion of the nineteenth century and the early decades of the twentieth century. Our investigations pertaining to such consumption were limited, generally excerpting information whenever encountered in the historical writings. More extensive research in this topical area should be conducted before attempting to assess the impact of emissions from burning wood in Butte.

*Cordwood Consumption - 1882.* A newspaper article written in 1882 boasted of the large amount of cordwood consumed by Butte mining companies in hoisting and smelting procedures as well as private use for home heating. It estimated smelter consumption at 5,000 cords per month, hoisting works use at 3,000 cords per month, for 25 operations, and domestic consumption at 2,000 cords per month. Approximately 1,200 to 1,500 persons were employed as wood cutters during this period (DD 1/16).

*Sawmills - Waste Burning.* Further research is needed to adequately depict sawmill operations in Butte. A brief review of the manuscript collection of "Clarence Strong Papers" in the University of Montana Archives indicates the operation of sawmills in Butte by the Montana Lumber and Manufacturing Company (1896-1897) and the Walter Cooper Company (1908 in Centerville). The MONTANA FOREST AND TIMBER HANDBOOK FOR 1926 lists two timber products producers in Butte. They were the Hudloff-Marquis Company and the Mines Timber Company, producers of mine timbers (DD 2/144).

The Montana Pole and Treating Plant on West Greenwood Avenue has been in operation since 1946. The plant manufactures pressure-treated wood products



and utilizes a tee-pee burner for waste disposal. A substantial file on this company's operation is available at the Air Quality Bureau. Therefore, little time was spent in researching data for the plant.

#### 4. *Miscellaneous Manufacturing*

Researchers discovered no data for miscellaneous manufacturing operations that would indicate a significant contribution to air pollution in the Butte area. Extended research would be necessary before any conclusions could be drawn, however. Operations which might be considered for further investigation include Lavelle Brothers Planing Mill, Cement and Sewer Pipe and Tile Company, Montana Iron Works, and Vulcan Boiler Works. Investigations involving old insurance maps and city directories likely would add additional operations to that list.

#### WESTERN IRON WORKS, INC.

This plant has been in operation in Montana since 1898. It has produced structural steel, trusses, columns, steel windows, fire escapes, ornamental railings, tanks, boilers, pipe, and mining equipment. The plant is located at 1400 East 2nd Street. No indication of emissions was discovered in this preliminary search.

### B. ANACONDA

#### 1. *Ore Processing*

#### ANACONDA CO. SMELTER(S)

A shortage of water in Butte forced Marcus Daly to consider other locations for his proposed copper smelting operations in 1882. In 1883 the copper magnate purchased land near Warm Springs Creek by the present Anaconda, Montana. By 1884 his first smelter, known as the Upper Works, was in operation. It was followed by construction of the Lower Works in 1887 and





the Washoe Smelter in 1902. A giant in the copper industry, the Anaconda Company's operations at Anaconda have been the source of numerous historical and technical writings, only a select number of which are referenced here.

Included under the "Emissions" and "Technical and Descriptive References" sections are bibliographical notes on air pollution and technical papers describing equipment.

#### ANACONDA COMPANY "UPPER WORKS"

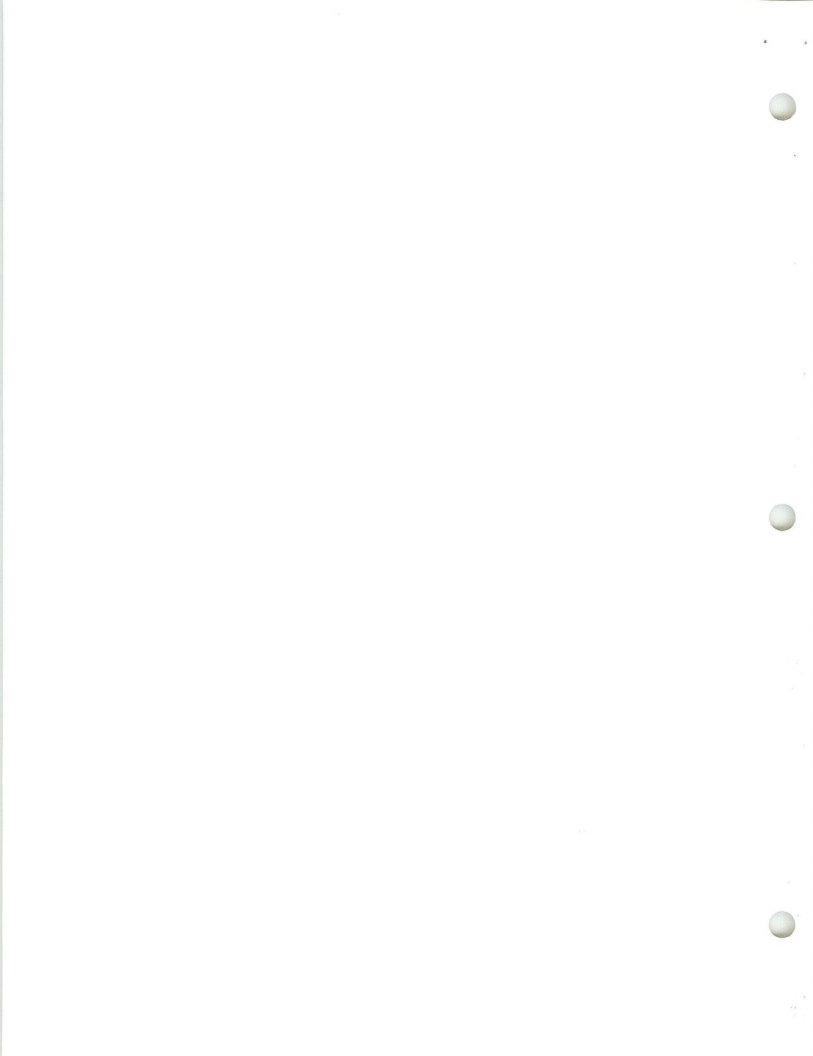
- LOCATION:** North side of Warm Springs Creek (A 1/16) in southern half of section 35 T5NR11W.
- CONSTRUCTION:** Commenced 1883, plant in operation in October, 1884 (A 40/609).
- TERMINATION:** November, 1901 (A 16/265).
- OWNERS:** Anaconda Copper Mining Company
- PROCESS:** The plant was used for reduction of copper ores. It employed a concentrator, hand roasters, and small reverberatory matte furnaces in that process. When reconstructed in 1886, the plant had steam stamps instead of crushers and rollers in the concentrator (I 33/26). Bruckner furnaces replaced the old hand roasters that year (I 33/26 and A 1/16).
- EQUIPMENT:** 1883-1884 - 34 hand-reverberatory roasting furnaces, hearths 50 x 14 ft. (A 16/267).  
2 ea. 70-ton water-jacket blast furnaces (A 16/265).  
26 reverberatory matting furnaces (H 1/27 and A 16/265).
- 1883-1886: Concentrator at Upper Works:
- "...No provision was made at first for the concentration of slimes, which were settled in tanks and sent to the smelter, but later on the Frue, Triumph and Embrey vanners were introduced; and the mill as completed may be described as follows:



1. Ore-bins, receiving ore from mines in railroad-cars; thence to (2).
2. Grizzlies; over-size to (3); under-size to (4).
3. Twelve Blake crushers; thence to (4).
4. Hoppers or bins; thence in cars, weighed and sampled, to (5).
5. Tulloch automatic feeders; thence to (6).
6. Six pairs of 15-by-27-inch rolls; thence to (7).
7. Six trommels, 3-mesh; over-size to (8); under-size to (9).
8. Six pairs of 15-by-27-inch rolls; thence back to (7).
9. Six trommels, 5-mesh; over-size to (10); under-size to (11).
10. Twelve 4-compartment Harz jigs, 4-mesh; concentrates to (21); tailings to waste.
11. Six trommels, 6-mesh; over-size to (12); under-size to (13).
12. Twelve 4-compartment Harz jigs, 5-mesh; concentrates to (21); tailings to waste.
13. Six trommels, 8-mesh; over-size to (14); under-size to (15).
14. Twelve 4-compartment Harz jigs, 6-mesh; concentrates to (21); tailings to waste.
15. Six trommels, 10-mesh; over-size to (16); under-size to (17).
16. Twelve 4-compartment Harz jigs, 8-mesh; concentrates to (21); tailings to waste.
17. Six hydraulic sizers; coarse to (18); overflow or slimes to (19).
18. Twelve 4-compartment Harz jigs, 10- and 12-mesh; concentrates to (21); tailings to waste.
19. Twelve settling-tanks; settlings to (20); overflow to waste.
20. Twenty-six Frue vanners, 10 Triumph and 10 Embrey vanners; concentrates to (21); tailings to waste.
21. Draining-floor; thence in cars to roasting-furnaces.

In 1886 Mr. Daly placed the works in charge of Mr. Otto Stahlmann, and experiments were made, having in view the reduction of cost of treatment. The results proved so satisfactory that all the old machinery was thrown out, and steam-stamps, Collom jigs, hydraulic separators and circular slime-tables were put in. The capacity of the plant was thus increased to 2000 tons per day." (A 40/609-610)

- 1889 - Combined "Upper" and "Lower" Works listed 14 steam stamps, 105 roasting furnaces, and 68 matting furnaces. 173 stacks were in operation (I 37/70).



## 1901 - Upper Works Equipment:

- a) 40 Bruckner roasting furnaces
- b) 4 MacDougall roasting furnaces (16 ft. diameter and 21 ft. high with 6 hearths)
- c) 4 Wetthey calciners with hearths 100 ft. by 12 ft.
- d) 11 reverberatory matting furnaces with hearths 31 by 16 ft., each with a capacity to treat 60 tons of ore per day (A 16/265-266).

## PRODUCTION STATISTICS:

1884 - Capacity of 500 tons of ore per day (I 33/26).

1884 - 23,000,000 pounds of copper (A 3/703).

1885 - 36,000,000 pounds of copper (A 3/703).

1886 - Plant changes resulted in capacity of 1,000 tons of ore daily (I 33/26).

1886 - 33,267,864 pounds of copper (A 3/703).

1887 - 57,000,000 pounds of copper (A 3/703)

## Combined Upper and Lower Works:

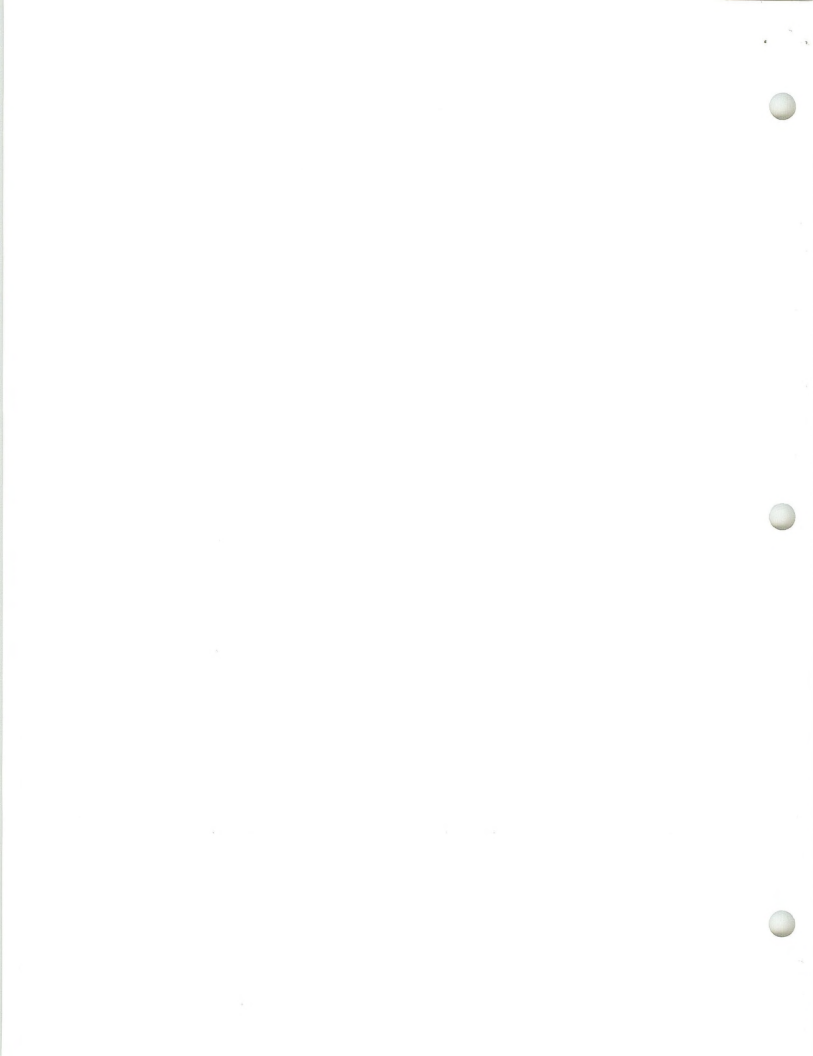
1888 - 63,254,473 pounds of copper (A 3/703).

1889 - 61,647,000 pounds of copper (A 3/703).

1890 - 64,046,812 pounds of copper (A 3/703).

1894 - Combined "Upper" and "Lower" Works treated about 4,000 tons of ore per day, consuming about 1,000 tons of coke monthly. Railroads carried to the plant an average of 435 tons of coal and 495 cords of wood per day (I 23/n.p.).

OTHER CITATIONS FOR UPPER WORKS: R 3, A 15.



## ANACONDA COMPANY "LOWER WORKS"

- LOCATION: Approximately one mile east of Upper Works on north side of Warm Springs Creek east of Anaconda, Montana
- CONSTRUCTION: 1887-1888, burned March 1889, rebuilt and in operation in fall 1889.
- TERMINATION: Circa 1902 with opening of Washoe Works.
- OWNERS: Anaconda Copper Mining Company.
- PROCESS: Reduction of copper ores by concentration, roasting, and smelting. (For details of process see A 16/266, H 1/28-46, J 9, H 4, and H 5.)
- EQUIPMENT:
- 1888 - a) 56 Bruckner cylinder furnaces 9'6" x 18'.  
b) 28 reverberatory matting-furnaces, hearths 22' x 16'.
  - 1899 - a) 4 MacDougall furnaces of Evans-Klepetko design added, 16' diameter by 21' high with 6 hearths.  
b) 7 of original 28 matting furnaces enlarged (A 16/266).
  - 1890 - a) 40 Bruckner furnaces added to original 56.  
b) Converter plant started, 15 stalls for upright vessels, 10' high, 6' in diameter, 6 blast furnaces (A 16/266).

Concentrator at Lower Works consisted of the following:

- "1. Seven receiving-bins; thence to (2).
2. Seven grizzlies, 1 1/4-inch bars, 1-inch spaces; coarse to (4); fine to (3).
3. Seven trommels, 3/16-inch round holes, perforated steel; coars to (3b); fine to (26).
- 3b. Seven elevators; thence to (4).
4. Seven steam-stamps (15 by 30-inch cylinders, 90 strokes per minute) screen 3/16 by 3/8-inch; thence to (5).
5. Twenty-eight hydraulic separators: 1st spigot to (6); 2d to (7); 3d to (80); 4th to (9); overflow to (22a).
6. Twenty-eight Collom jigs, 4- and 8-mesh: 1st sieve-discharge to (37); 2d to (37); 1st sieve-hutch to (37); 2d to (37); tailings to (10).





Since the above notes were taken changes have been made, among which are the following:

Ore which is notably soft is crushed by a steam-stamp having screens with 1/2-inch round holes, and 1-sieve Harz jigs are used, the tailings from which are crushed by a steam-stamp through 1/4-inch round-hole screens.

Collom jigs have been substituted for the circular jigs. Cornish rolls are now used instead of Heberle grinders." (A 40/610, 613; for further detail on the concentrator at the Lower Works, see A 40/611, 612).

Note: Electrolytic Refining Plant started in 1894, refined ore from both Upper and Lower Works and from Washoe Works in early 1900's. (A 16/266. See also ENGINEERING AND MINING JOURNAL, March 1, 1902, p. 311.)

#### PRODUCTION STATISTICS:

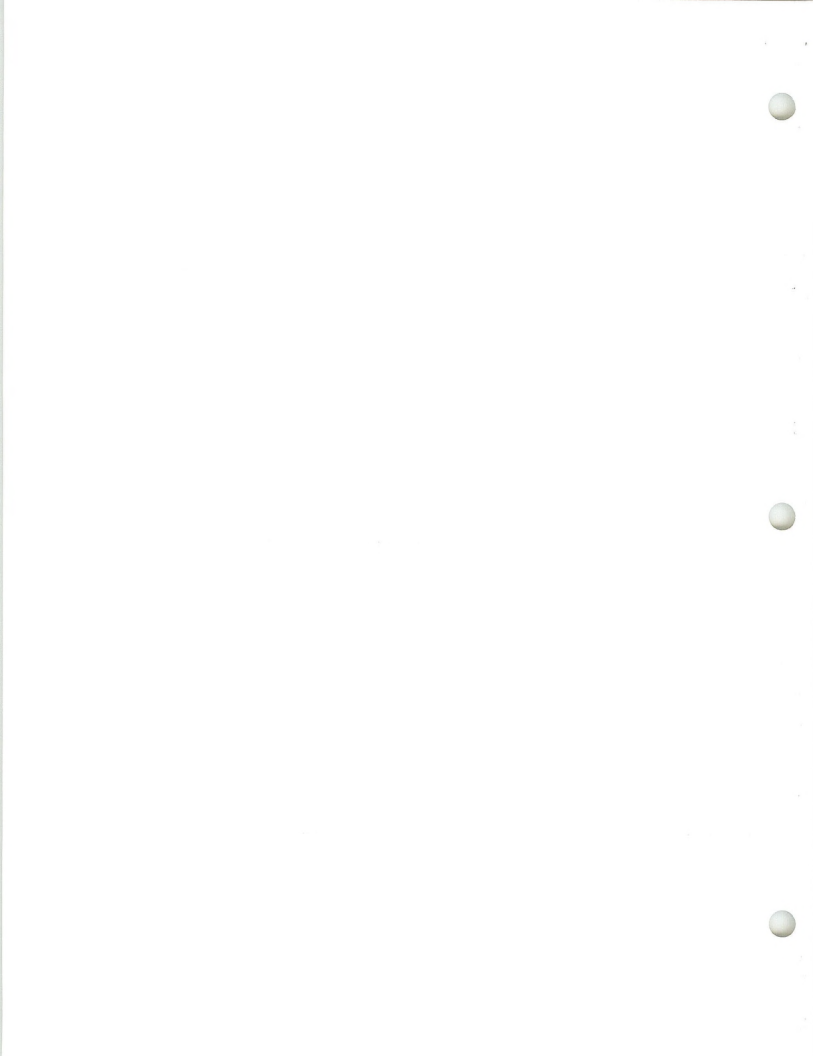
(See combined statistics with "Upper Works.")

The following figures are total Anaconda Co. output:

1893 -	75,256,657	pounds of fine copper/ Upper & Lower Works	
1894 -	95,578,000	"	"
1895 -	99,775,294	"	"
1896 -	125,350,693	"	"
1897 -	131,471,127	"	"
1898 -	107,214,059	"	"
1899 -	107,914,357	"	"
1901 -	101,850,224	estimated	
1902 -	75,000,000	"	" (A 7/169)

When Amalgamated Copper Co. took control in 1899, they ceased to issue production statistics (A 6/164).

OTHER CITATIONS FOR LOWER WORKS: I 23, I 37, R 3, A 15, A 14, A 2, H 1/51-53.



ANACONDA REDUCTION WORKS  
(Also known as New Works or Washoe Works)

- LOCATION:** Anaconda, Montana, on hillside 2 miles east of town, current smelter site.
- CONSTRUCTION:** Ground broken May, 1900 (A 18/328), operating in Feb., 1902, with 4 stacks, each 225 ft. high. In 1903, large stack constructed. Between opening on Jan. 25, 1902, and Feb. 1903, the Company allegedly paid over \$330,000 in claims brought against it for damage from emissions (A 1/67).
- TERMINATION:** Currently operating.
- OWNERS:** Anaconda Company
- PROCESS:** Reduction of copper-bearing ores through use of concentration plant, blast and reverberatory furnaces, and converters. This over-simplified explanation of process comes from a more detailed description of the process in 1911 (A 18/328-337). Equipment has changed over the years. The basic process, however, remains the same. See also I 19 and I 22 for process.
- The Anaconda Company has published several pamphlets describing its Anaconda plant. Samples of those pamphlets are in the bibliography as items I 24 (post 1927), I 25 (1909), I 26 (1913), and I 29 (1919).
- EQUIPMENT:**
- 1902 - a) 48 6-hearth MacDouglass-Evans-Klepetko roasting furnaces, 16 ft. diameter and 21 ft. high (A 16/267).
  - b) 5 blast furnaces, 56 x 180 inches at the tuyeres and 14 ft. 10 in. high (A 16/267).
  - c) 14 matting-reverberatories (hearth 20' x 50'2").
  - d) 8 converter-stands (barrels 12'5" long and 8' in diameter) (A 16/267).
  - e) Emissions from the four departments went through 4 steel stacks, 200 ft. high and lined. Inside diameter 20', outside diameter 23'6" (A 16/267; see also I 30/331-337).
  - 1903 - a) Addition of 300 foot stack with connecting flues to four departments previously on individual 225-foot stacks (A 1/67).



- 1904 - Arsenic plant constructed near lower end of 60-foot main flue. Plant consisted of Brunton roasting furnace to treat flue dust, reverberatory furnace to treat crude arsenic from roasting furnace, plants for condensation of fumes and grinding and barreling machine to prepare arsenic for market (I 10/324).
- 1910 - Concentrator machinery replaced with same type in operation at Great Falls.
- 1911 - See detailed account in A 18/328-337.
- 1913 - a) Construction began on round table plant to handle slime material.  
 b) 80 ton leaching plant constructed.  
 c) One twenty-foot cylindrical converter of the Great Falls variety added to converter department (G /1913).
- 1914 - a) Round table plant completed.  
 b) Work progressing on 2000 ton leaching plant.  
 c) 100 ton acid plant under construction--most of product to be used in 2000 ton leaching plant.  
 d) One reverberatory furnace equipped with coal dust firing machinery as test--rest of plant to be converted to use of pulverized coal (G /1914).
- 1915 - a) 2000-ton leaching plant in operation.  
 b) 100-ton acid plant operating.  
 c) New roaster plant installed with 40 furnaces, each 25 feet in diameter.  
 d) Converter department equipped with converters of Great Falls variety and new reverberatory furnace (175 ft. long by 25 feet wide) installed to clean converter slag.  
 e) Crushing capacity increased and new flotation process begun (G /1914).  
 f) 10-ton electrolytic zinc plant put into operation late in year. This plant soon replaced by 25-ton plant which was dismantled in 1916 (I 1/463).
- 1916 - Oil-flotation process zinc concentrator installed, capacity 2,000 tons of zinc ore per day, began operation September (G /1916).
- 1917 - a) Additional 50-ton acid plant installed.  
 b) Work begun on Cottrell treater system and new stack (to be 525 feet high) (G /1917).
- 1918 - a) New stack completed, 585 feet high, inside diameter 70 ft. at bottom and 60 ft. at top.  
 b) Three earth dams to impound tailings begun (G /1918).



- 1919 - a) Smoke treatment plant of 20 Cottrell treater units in operation.  
b) Old stack dismantled.  
c) Construction of arsenic refining plant begun (G /1919).
- 1920 - a) Completed 50-ton phosphate plant, treated 1500 tons of rock per month, yielding 900 tons per month treble super-phosphate.  
b) Completed arsenic refining plant.  
c) At end of year baghouse built to recover fume from gases leaving arsenic plant (G /1920).
- 1921 - No additions noted in shareholder reports.
- 1922 - No additions noted in shareholder reports.
- 1923 - Added new fertilizer plant to manufacture super-phosphate (G /1923).
- 1927 - 170 ton electrolytic zinc plant installed (I 1/463).
- 1931 - Natural gas apparatus replaced coal-burning devices at smelter (I 38).
- 1941 - Manganese concentrator and nodulizing plants completed. For description see J 12.
- 1958 - Ammonium phosphate plant completed (I 38).
- 1961 - Phosphate plant closed (I 38).
- 1964 - Arsenic plant shut down (I 38).
- 1966 - Fifth converter added (I 38).
- 1969 - Sixth converter added (I 38).

In addition to equipment installations, plant closures, strikes, and miscellaneous information is included in the annual reports to shareholders.

#### PRODUCTION STATISTICS:

- 1904 - 5,500 tons of smelting and concentrating ore treated daily, yielding 350,000 lbs. of copper (J 8/532).
- 1905 - Capacity changed from 2,700 tons of ore to 4,700 tons of ore treated daily (A 1/70).





1905 - 7,000 tons of ore treated daily with yield of 500,000  
 lbs. of copper.  
 Coal consumed - 600 tons daily.  
 Coke consumed - 400 tons daily.  
 Flue dust produced - 190 tons daily.  
 Lime rock used - 1,600 tons daily.  
 Slag and tailings produced - 9,000 tons daily.  
 (J 8/533).

1907 - 64,154,636 lbs. of copper produced by Anaconda (A 8/69).

1908 - 67,064,000 " " " "

1909 - 79,049,150 " " " "

1910 - 3,302,523.46 dry tons of ore and other cupriferous  
 material treated at Anaconda Co. (G /1910).

Note: In the "G" section, the numbers after the slash  
 indicate year rather than page number.

167,507,409 lbs. fine copper (G /1910)  
 7,107,696.411 ounces silver (G /1910)  
 38,564,652.2 ounces gold (G /1910).

1911 - 3,154,035.94 dry tons of ore and other cupriferous  
 material treated  
 191,573,780 lbs. find copper produced  
 8,510,122.14 ounces silver  
 40,546.216 ounces gold (G /1911).

1912 - 3,880,203.37 dry tons of ore and other cupriferous  
 material treated  
 222,763,670 lbs. of fine copper produced  
 9,702,604.52 ounces silver  
 52,563.891 ounces gold (G /1912)

1913 - 4,016,689.16 tons of ore and other cupriferous (G /1913)

1914 - 3,748,726.49 tons of ore and other cupriferous  
 material treated (G /1914).

1915 - 4,421,628.69 tons treated (G /1915).

1916 - 5,193,572.64 " " (G /1916).  
 8,320,522 lbs. of electrolytic zinc produced (G /1916).

1917 - 4,267,854 tons ore treated (G /1917).

1918 - 4,959,580 " " " (G /1918).

1919 - 2,340,100 " " " (G /1919).



1919-1925 - Similar data available from shareholder reports. Later annual shareholder reports do not give breakdown of production per plant. Such data likely would be available from Anaconda Company records.

#### EMISSIONS:

Emissions from the Anaconda Reduction Works (Washoe Works) have plagued the operators since it first started operating. Those emissions have resulted in numerous law suits and technical papers, some of which are references in the following bibliographical items: X 1, J 1, J 2, J 3, J 7, I 9, I 10, I 11.

#### TECHNICAL AND DESCRIPTIVE REFERENCES (Equipment and Process):

- I 2 (1923 phosphate plant)
- I 3 (1923 leaching plant)
- I 4 (1922 reverberatory smelter)
- I 5 (1922 calcining)
- I 6 (1922 concentrator and flotation)
- I 8 (1923 sulphuric acid plant)
- I 9/305 (Cottrell treaters and use at Anaconda)
- I 12 (No. 5 reverberatory furnace)
- I 14 (1916 reverberatories operating on pulverized coal)
- I 18 (1922 converting and casting)
- I 20 (1920 acid or "packed cell" plant)



## *2. Public Utility Plants*

No information concerning this topic was found in the preliminary search. As with the same topic for Butte, it is possible that Montana Power Company would have some information.

## *3. Timber Products Industry*

Sanborn Insurance Company maps at the Montana Historical Society listed the Montana Lumber & Produce Company planing mill at the corner of Elm and West Front in 1891. The plant had a boiler or incinerator with a 35-foot iron stack. The same map indicated a planing mill of Noble and Ehret at the corner of East Third Street and Alder. That plant had a 40-foot iron chimney. In 1896, the Sanborn map showed a planing mill of J. T. Carroll off Commercial Avenue near the B.A. & P.R.R. Depot. These maps are available for other years and would be a useful aid in further research as they list chimneys and boilers. City directories and items such as the MONTANA STATE GAZETEER AND BUSINESS DIRECTORY may provide additional listings.

## *4. Miscellaneous Manufacturing*

Other than brick and tile manufacturing firms shown on Sanborn Insurance Company maps in the 1890's, the only significant "miscellaneous" manufacturing firm researched was a foundry located in the southeast section of Anaconda near the present smelter. The operation began as the Tuttle Manufacturing and Supply Company, a heavy foundry and hardware concern (I 40/5 and R 3/27). Sometime between 1889, the founding date, and 1905, the company became a department of the Anaconda Copper Mining Company. Today it remains under ownership of the Anaconda Company.

The plant contained pattern shops, iron and brass foundries, machine and blacksmith shops, and boiler and electrical departments. The iron foundry had large and small core ovens. It has produced many of the crushing machines and smelting and refining furnaces used by the Anaconda Company in its ore reduction operations (R 3/29).

A report entitled "A Study of Air Pollution in Montana: July 1961-July 1962" by the Montana State Board of Health indicated that the Anaconda foundry,



perhaps the same one, emitted sulfur dioxide, oxides of various metals, oxides of nitrogen and coal smoke, tars, and fumes (L 2/34).





### III. DOMESTIC AIR POLLUTION SOURCES

#### A. BUTTE

##### 1. *Automobiles*

Statistics for the number of vehicles operated in Butte are best discerned by reviewing records and reports of the State Department of Revenue, formerly the Montana State Board of Equalization. Although the number of vehicles is given per county, rather than by city, that information provides an approximate figure per city when compared with population statistics.

Other sources investigated were tag plant records at the State Prison, county assessor records, and records of the Registrar of Motor Vehicles. The latter two sources were found to be too costly to use. The tag plant numbers were estimates only.

As an example of State Board of Equalization records, the 1924 Biennial Report listed 6,000 automobiles and trucks in Silver Bow County for 1923 and 7,000 cars and trucks in 1924 (V 2/78). For 1973 the number of cars was 18,080, and trucks numbered 5,789 (V 1/114).

##### 2. *Population Statistics*

It is necessary to evaluate population statistics for use with the automobile figures and the home heating data. A rough estimate of the number of vehicles operating in Butte may be established by determining what percentage of Silver Bow County's population lived in the city and by applying the same percentage to the number of registered vehicles operated in the county. For home heating information, it would be possible to relate the number of gas and electric meters with the total population, assuming that structures without meters likely were heated by other means.

Census data for Butte provides the following population information:

1870	-	241
1880	-	3,363
1890	-	10,723
1900	-	30,470
1910	-	39,165



1920 - 41,611  
 1930 - 39,532 (56,969 for Silver Bow County)  
 1940 - 37,081  
 1950 - 32,904 (census figures 1870-1950 taken from card catalogue at Montana Historical Society)  
 1960 - 27,877  
 1970 - 23,368 (U.S. Dept. of Commerce, Bureau of the Census)

Walkerville in 1970 had a population of 1,097 persons, down from 1,453 in the 1960 census (see File "U").

### 3. Catastrophic Fires

No definitive source of information for fires in Butte was uncovered in the preliminary investigations. It appears, however, that records of the State Fire Marshall would be helpful. For example, annual reports from that office listed 128 fires in Butte in 1917 and 75 fires in the 1930-31 fiscal year. It would be possible to collect that data from each of the annual reports if deemed significant. Further investigations with records within that office (i.e., individual fire reports) might disclose information pertinent to the study (Q 1/30, Q 2/11).

A Butte newspaper article in 1954 listed "major fires" from 1895 to 1950. That list is included below (from Q 3/168).

## Butte Fires Since 1895 Claimed Heavy Toll in Lives and Dollars

A list of Butte's major fires, with the dates, loss of life—if any—and estimated property loss given, follows:

Jan. 15, 1895—Explosion, Box 72; 10 p. m., 57 lives lost; \$122,100.

May 31—Butte Reduction Works, 2:10 a. m.; loss not estimated.

March 21, 1898—Hale House, Box 34; 3:10 a. m.; four lives lost; \$90,000.

Nov. 10, 1899—Big Blackfoot Milling Co., Box 54, 11:50 p. m.; \$10,000.

Jan. 7, 1900—Hennessy Warehouse, Box 72; 4:50 a. m.; \$20,230.

June 20, 1900—Reed Barn, 236 South Main; \$34,000.

July 13, 1901—Butte Hotel; 2:30 a. m.; \$10,000.

Aug. 30, 1901—Kennedy Furniture Co., Box 113; 6:15 p. m.; \$13,000.

April 21, 1903—Olsen & Christie, Box 72; noon; \$29,000.

April 4, 1905—Adelaide Block, Box 62; 11:14 p. m.; \$15,800.

April 16, 1905—Western Lumber Co.; 1:45 a. m.; \$17,033.

Sept. 24, 1905—The Symons Store (and other buildings); 8:30 a. m.; \$698,000.

March 26, 1906—Olsen & Christie; 6:50 p. m.; \$50,300.

April 22, 1908—Palace Stables, Box 84; 10:30 p. m.; \$10,000.

Feb. 11, 1911—St. Joseph Church, 12 noon; \$15,000.

Jan. 11, 1912—Henningsen Produce Co., 4 a. m.; \$21,000.

April 10, 1912—Olsen & Christie, 12:03 p. m.; \$295,000.

May 23, 1912—Empress Theater, Box 42, 7:23 a. m.; \$24,500.

July 30, 1912—Creamery Cafe, 4:45 p. m.; \$48,692.

Sept. 1, 1912—Thomas Block, 12:05 p. m.; \$220,935.

Oct. 18, 1912—H&B Block, Box 42, 1 a. m., \$49,381.

Nov. 17, 1912—Sacred Heart Church, 9:30 p. m., \$26,000.

Jan. 13, 1913—Brownfield Canby Co., 7:15 a. m., \$22,500.

Jan. 17, 1913—Foster Block, 5:15 a. m., \$15,000.

Dec. 29, 1913—Ivanhoe Block, 5:15 a. m., \$15,000.

March 20, 1918—Wolfstone Block, 1:25 a. m.; one life lost, \$10,250.

June 30, 1918—Montana Mattress Co., 5:58 p. m., \$15,500.

May 25, 1919—707 West Granite, 2:10 p. m., \$15,000.

Aug. 18, 1919—Ryan Fruit Co., Box 72, 2 a. m., \$112,569.

Nov. 23, 1919—Montana Hardware Warehouse, 9:06 p. m., \$126,200.

Dec. 14, 1919—McKinley School, 10:37 p. m., \$51,619.

Feb. 14, 1920—Tripp and Dragstedt, 7 a. m., \$93,806.



April 15, 1920—Shiner Furniture Co., 12:50 a.m., \$13,765.  
 Sept. 24, 1920—Peoples Theater, 2:10 a.m., \$23,000.  
 Oct. 15, 1910—Oleona Dance Hall, 1:30 a.m., \$11,500.  
 April 22, 1921—Braund House, 4:40 a.m., no estimate given.  
 April 17, 1921—Aliner Publishing Co., 5:55 a.m., \$25,000.  
 April 8, 1921—Rampou Cafe, Box 123, 2:45 a.m., \$19,000.  
 Aug. 17, 1924—Ryan Fruit Co., 9:09 a.m., \$11,500.  
 Aug. 24, 1924—50-63 East Park, Box 123; 2:20 a.m., \$25,517.  
 Jan. 18, 1927—Henningsen Co., 3:55 p.m., \$19,500.  
 Feb. 14, 1927—Silver Bow Block, 7:42 a.m.; William Gemmell lost life; \$23,495.  
 June 9, 1927—Ryan Fruit Co., 5:57 a.m., Fireman William Gleason, died; \$27,300.  
 July 30, 1927—Largey Lumber Co., 3 p.m., \$20,000.  
 Aug. 14, 1923—1131-33-45 Anthony St., 8:45 p.m., \$21,769.  
 April 10, 1930—114 South Main, 9:16 p.m., \$20,000.

Nov. 20, 1930—Bank Hotel, 11:55 p.m., \$79,500.  
 March 30, 1931—Murphy Money Back Store, 3:22 a.m., \$10,500.  
 April 15, 1931—Empress Theater, 8:11 p.m., \$17,457.  
 Sept. 28, 1931—Brody's, Park and Wyoming, 6:05 p.m., \$29,650.  
 May 9, 1932—Columbia Block, 3:35 a.m., \$125,428.29.  
 Oct. 9, 1932—Mayer Building, 4:45 a.m., \$60,600.  
 Dec. 25, 1933—Colbert Drug, 58 West Park, 8:06 a.m., \$22,102.  
 Dec. 4, 1935—58 West Park, Hughes, 7:26 p.m., \$10,283.  
 April 10, 1937—Longfellow school, 5:25 p.m., \$50,795.  
 May 4, 1939—315 West Broadway, 12:26 p.m., \$12,703.40.  
 Nov. 1, 1940—Boston Block, 118 South Main, 10 p.m., \$54,161.82.  
 March 23, 1942—Casey Candy Co., 2:15 a.m., \$17,000.  
 Dec. 19, 1943—Safeway Warehouse, 12:28 p.m., \$54,000.  
 Oct. 2, 1943—33 West Park, Pinsel's 4:17 a.m., \$18,343.  
 April 2, 1945—Woman's Club, Park and Clark, 10:43 a.m., \$10,000.

May 26, 1915—Columbia Market, 125 South Main, 8:35 p.m., \$16,330.  
 Oct. 21, 1915—Western Iron Works, 1300 East Second, 2:52 a.m., \$12,700.  
 April 10, 1946—Old Butte High School, 9:35 p.m., \$320,000.  
 May 25, 1943—1660 Harrison Ave., Tire Repair Shop, 12:36 p.m., \$140,000.  
 Dec. 24, 1948—Western Iron Works, 9:40 p.m., \$40,000.  
 Sept. 23, 1949—Park Theater, 2:10 a.m., \$20,000.  
 Jan. 8, 1950—Winter Garden Bowling Alleys, 6:25 a.m., \$50,500.  
 Feb. 1, 1950—American Theater, 3:22 a.m., \$74,000.  
 Oct. 18, 1951—Vroom Block, 3 a.m., four died; \$100,000.  
 Feb. 2, 1953—Whittier School, 10 p.m., \$19,000.  
 Jan. 20, 1954—Butte YMCA, 7:30 a.m., \$100,000.  
 In several instances in the above list of fires the name of the fire is taken from the site of origin, and the report does not list other properties either destroyed or damaged by the fire.

#### 4. Street Paving, Sanding, and Cleaning

The Butte-Silver Bow Public Works Department did not respond to a letter requesting information concerning street paving, sanding, and cleaning. Historical Research Associates contacted the agency in writing on March 15, 1978. The firm asked for specific information regarding those topics mentioned above and/or location/description of records that might pertain to the study. In a personal appearance at the Butte offices, the firm representative found Public Works Department personnel cooperative but without authority to grant Historical Research Associates access to the desired records.

It is possible that the records for street operations are not available in a form that would make them useful to this study. If they are available, the expense in retrieving them might far outweigh their usefulness.

Scattered references to street paving and cleaning were found in library documents at the University of Montana. A 1939 report of an economic survey in Butte showed 93 miles of streets in the city. More than 55 miles (approximately 60%) were oiled or paved (\$ 1/51). A report of the Montana Society



of Engineers recorded 10,705 square yards of granite block pavements laid in 1899 (N 1/33). A similar report by the same group in 1918 indicated .35 of a mile of alley paved, 1.02 miles of street paved (Bitulithic), and 1.67 miles of street graded in 1917 under the direction of the city engineer and public works commissioner (N 2/40).

Street sprinkling began prior to the advent of the twentieth century in Butte. Records disclosed to date, however, do not depict the extent or regularity of such operations.

#### *5. Home Heating, Cooking, Indoor Lighting*

At the outset of this study, it was hoped that information concerning domestic consumption of wood, coal, gas, and electricity for home heating, cooking, or lighting purposes would be available through previous economic studies on Butte, railroad records, public utility records, or journals devoted to the coal, wood products, or utilities industries. Researchers did not have time to probe these sources thoroughly, but preliminary indicators were discouraging. Montana Power Company was not contacted. Its records may prove useful in obtaining early information on the numbers of electric and gas installations. The Public Service Commission's records may contain similar information.

A 1939 economic survey of Butte revealed 10,379 domestic electric meter connections, an average of 102 per 100 families that year. That was more than twice the average for Montana as a whole (S 1/87).

The same report mentioned that railroad records did not provide detailed data for types and amounts of incoming freight. That statement indicates that researchers should not rely on railroad records for information concerning the volume of coal shipped to Butte.

With the cooperation of the Montana Power Company, it may be possible to list the number of gas and electric connections in Butte. When considered with population data or the number of households, it might then be possible to estimate the number of residences using coal or wood for heating and cooking purposes. In any event, the documentation would be sketchy and analysis questionable. As time prohibited the use of industry-related





journals for this phase of the study, it is not known whether supplementary data from such writings would contribute significantly to the evaluation of domestic use of coal, wood, gas, or electricity in Butte.

One early article pertaining to Butte listed domestic consumption of cordwood at 2,000 cords per month in 1882 (DD 1/16). Without further information, it cannot be determined whether that was typical cordwood consumption in the Mining City for early years.

## B. ANACONDA

### 1. *Automobiles*

See III.-A.-1 for a discussion of sources for motor vehicle statistics.

Examples: A State Board of Equalization report for 1924 indicates 1,223 automobiles and trucks operating in Deer Lodge County for 1923 and 1,035 vehicles registered the following year (V 2/78). In 1973, the Department of Revenue listed 5,942 automobiles for Deer Lodge County and 2,089 trucks (V 1/114).

### 2. *Population Statistics*

Shortage of time prohibited a search of Census Bureau publications to ascertain population figures for Anaconda. They would be readily available if determined to be of relevance to the study. (See II-A-2.)

In 1892 Anaconda had 3,975 residents (V 2/27). Other records show Anaconda's population at 9,771 in 1970, 12,054 in 1960, and 11,254 in 1950.

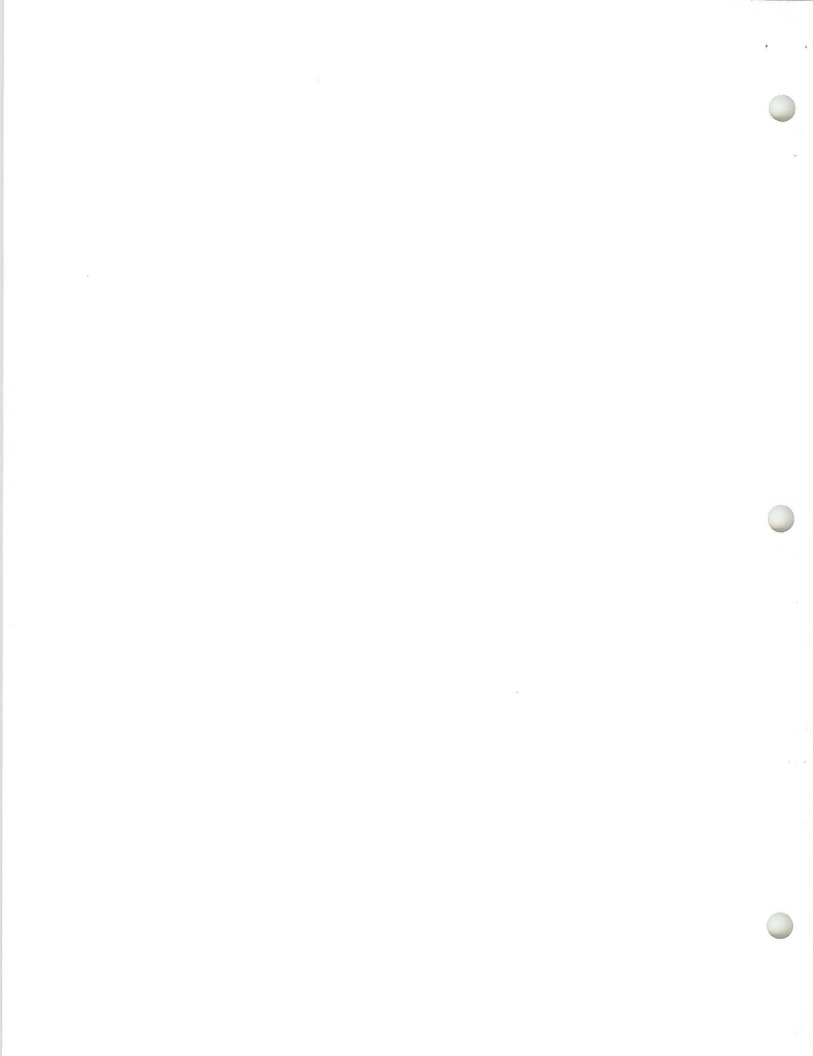
### 3. *Catastrophic Fires*

See III-A-3 for a discussion of State Fire Marshall records.

As an example of library sources, the reports of the State Fire Marshall for 1917 listed 12 fires as compared to Butte's 128 for the same year (Q 1/30). In 1930, Anaconda had 22 fires, while Butte had 75 (Q 2/11).

### 4. *Street Paving, Sanding, and Cleaning.*

The following information was provided by the Anaconda-Deer Lodge County office of the Director of Public Works.



### "City Streets

The City of Anaconda has approximately 28 miles of paved streets. Approximately 20 miles of streets were paved in the 1930's by the W.P.A. and the additional 8 being paved in the early 1950's by the City when a housing boom took place in the Western end of the City. The history of the City Street Dept. has been one of maintenance of City Street & Sewers rather than construction or reconstruction. The maintenance has taken the form of patching with some overlay work being done. Material was of cold mix types. The past 6 years a reconstruction program has been taking place in various parts of the City through the use of State and Federal Funds (Gas Tax Revenue) and under private contract. In that time approximately 8 miles have been reconstructed using this program. In the future the City hopes to have its own Reconstruction Program.

### Sanding

The City Street Dept. has a sanding program which takes place when required. In the past the Street Dept. has used slag from the local Smelter (quantities not available) but during the past winter the streets have been sanded with a 1/4"-material (400 C.Y.); this material when weather permitted was recycled and used again.

### Street Sweeping

The Street Dept. has a flusher (water wagon) and two sweepers (water type). The entire City is done in the spring (weather permitting) and at various times during the Summer and Fall. The business district is done on a regular basis during the early morning hours." (Y 1)

### *5. Home Heating, Cooking, Indoor Lighting*

The same difficulties were found in this research as were found for the same topics in Butte (see III-A-5). Again, records of power companies and local fuel dealers would be useful, though a shortage of time precluded researchers' investigations with those sources.

A 1941 study by the Work Projects Administration did provide some data. In that year less than one-fourth (851) of the residential dwellings in



Anaconda had central heating systems. The other three-fourths had gas, coal, or wood stoves, with the exception of 3.1 per cent which had no heating at all (R 2/23).

The same survey showed 99 per cent of Anaconda's residences were lighted by electricity. Only one per cent were lighted by gas or other means. Cooking in 14.4% of the structures was done with electricity, 36% with gas, and 48.4% with other means (probably wood or coal) (R 2/23).

In 1961-62, the Montana State Board of Health conducted a "Study of Air Pollution in Montana." That study indicated that the major sources of air pollution in Anaconda were industrial processing, domestic use of fuel, and burning of waste materials. The study used fuel dealer contacts and public utility company information to determine the amount of coal, natural gas, fuel oil, propane, wood wastes, and trash burned per year. A copy of that study should be on file with the Air Quality Bureau, and should be used in conjunction with this inventory (L 2/35).\*

\*Note: This study contains similar information for Butte. It also has data on industrial pollution and vehicular pollutants.



#### IV. BIBLIOGRAPHY

The following bibliography was designed especially for this "Historical Emissions Inventory." It is arranged topically to better serve technical interpretation. The topical headings are indicated after a capital letter (i.e., "A. Butte Smelters and Reduction Works"). Books, articles, etc., follow the topical heading as they were arranged in Historical Research Associates' project files. Those files contain photocopies of most of the pertinent data used in this report and are to be turned over to the Air Quality Bureau upon completion of the inventory. This bibliographical format, then, is meant to be used with those topically segregated files. To aid researchers or other interested parties without access to the original files, an alphabetical list of authors is appended to show where writings by particular authors may be found in this report's topical bibliography.

Example: When a note in the text or alphabetical author list cites (A 3/703), it refers to the topical heading "A. Butte Smelters and Reduction Works"; item number 3, Douglas James, "The Copper Resources of the United States," TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS, vol. 19 (1890-91); page number 703.

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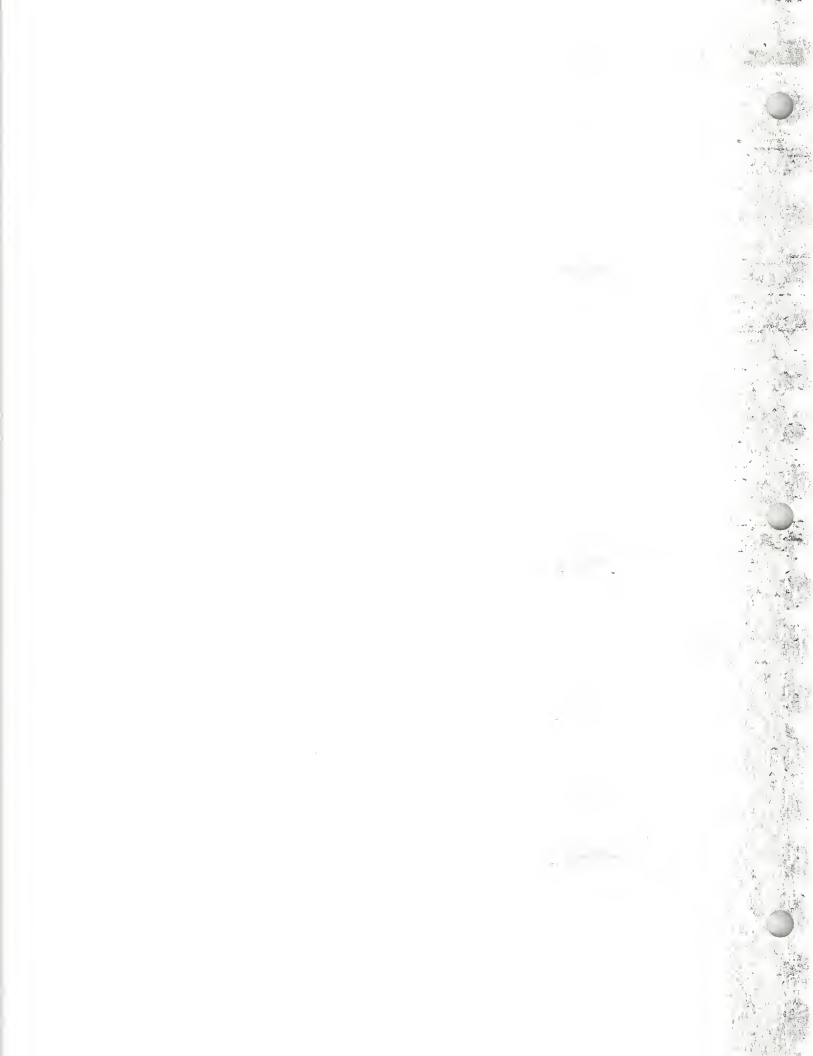
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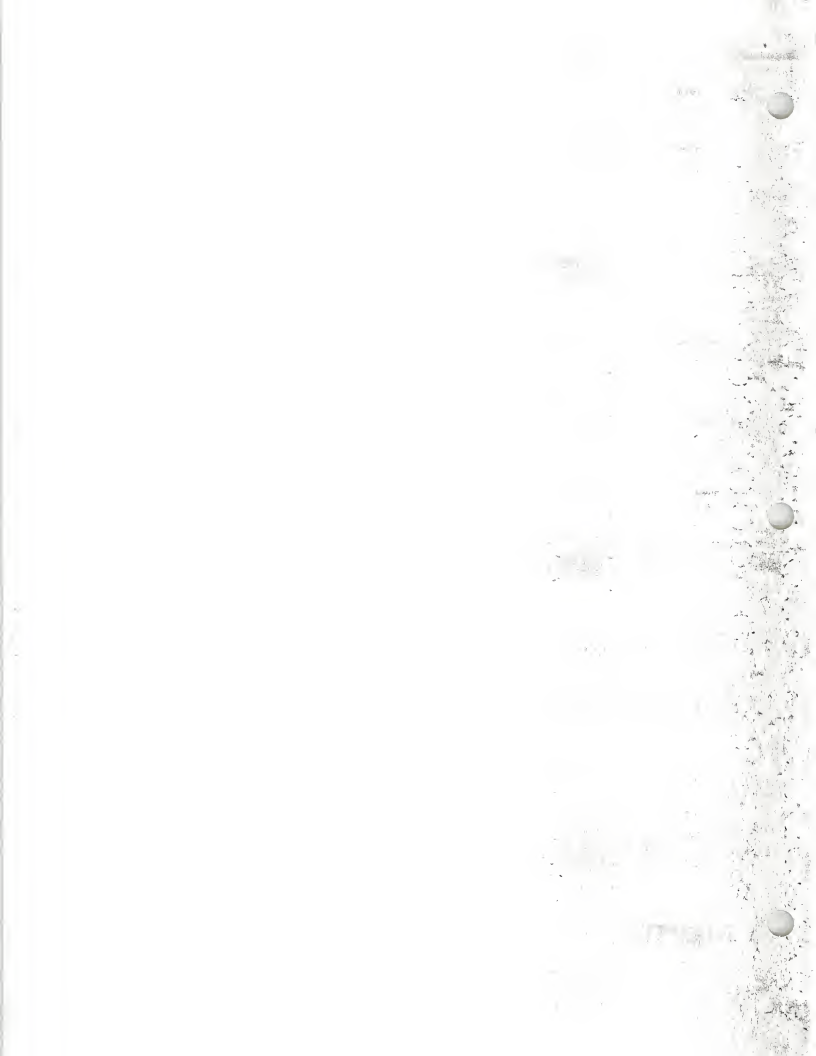
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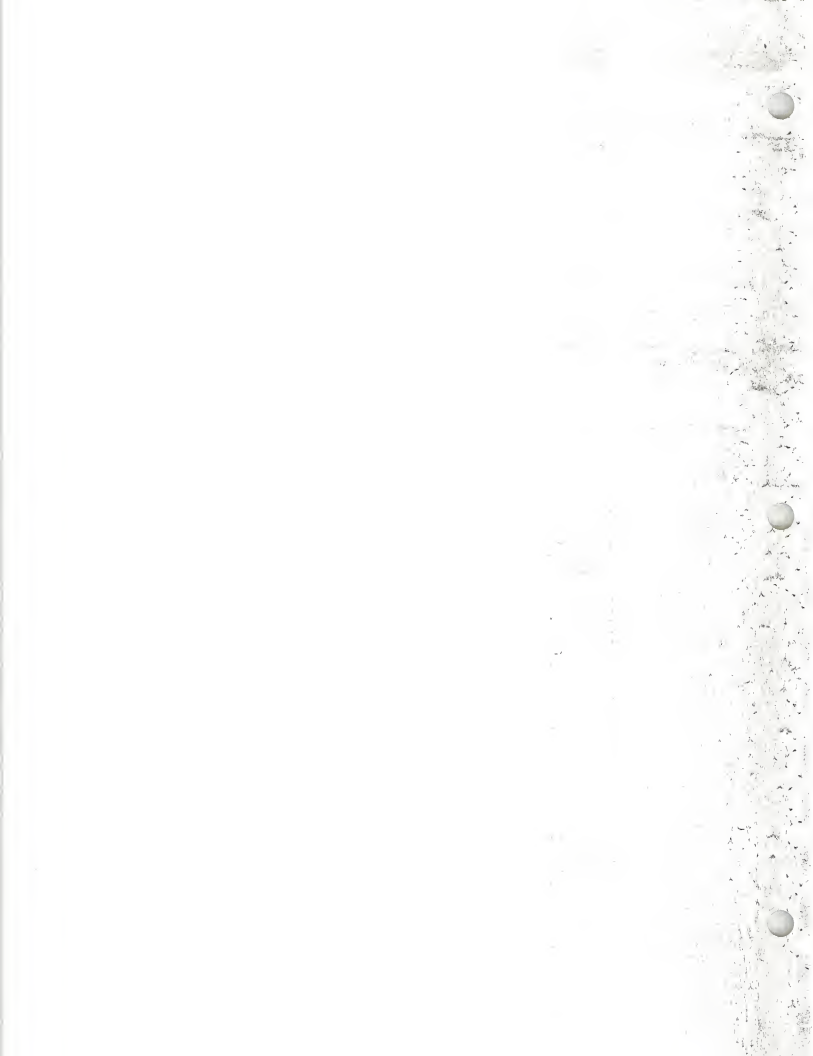


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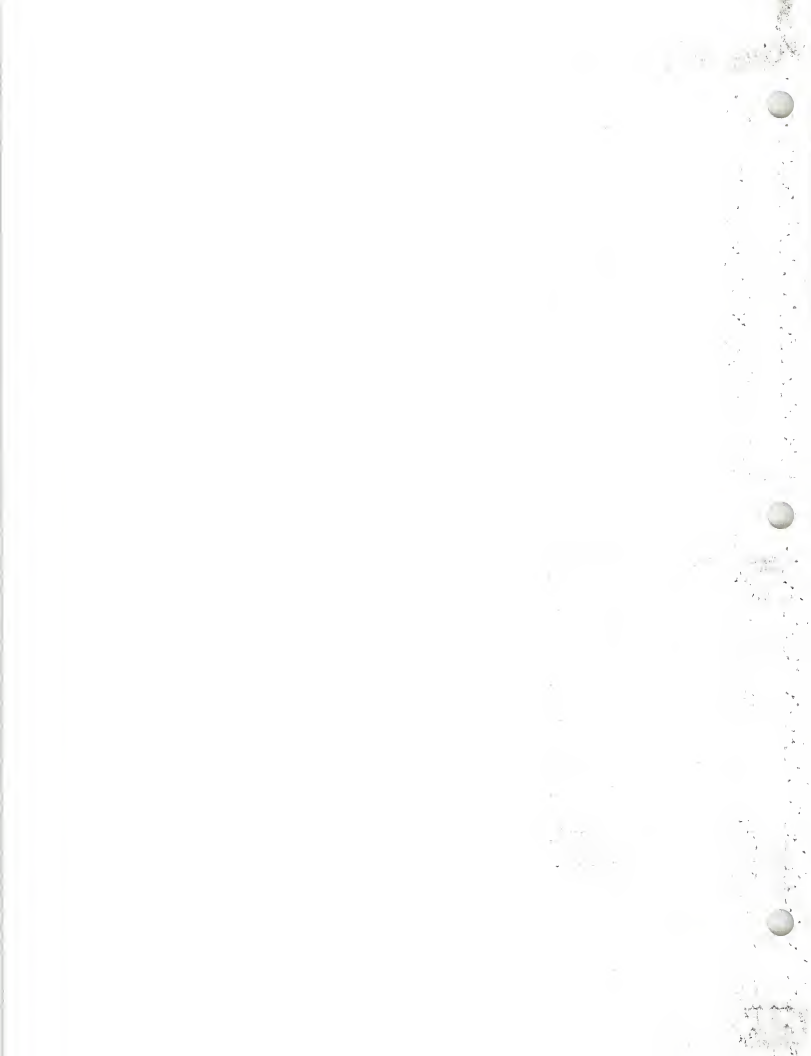
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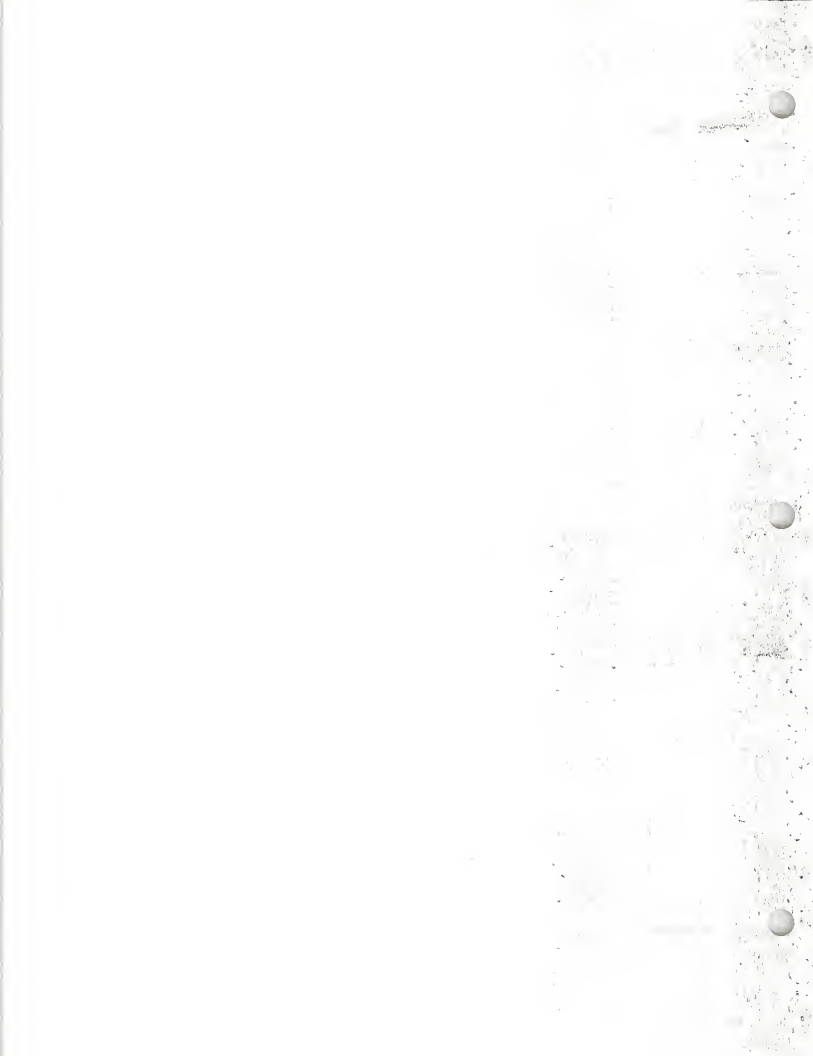
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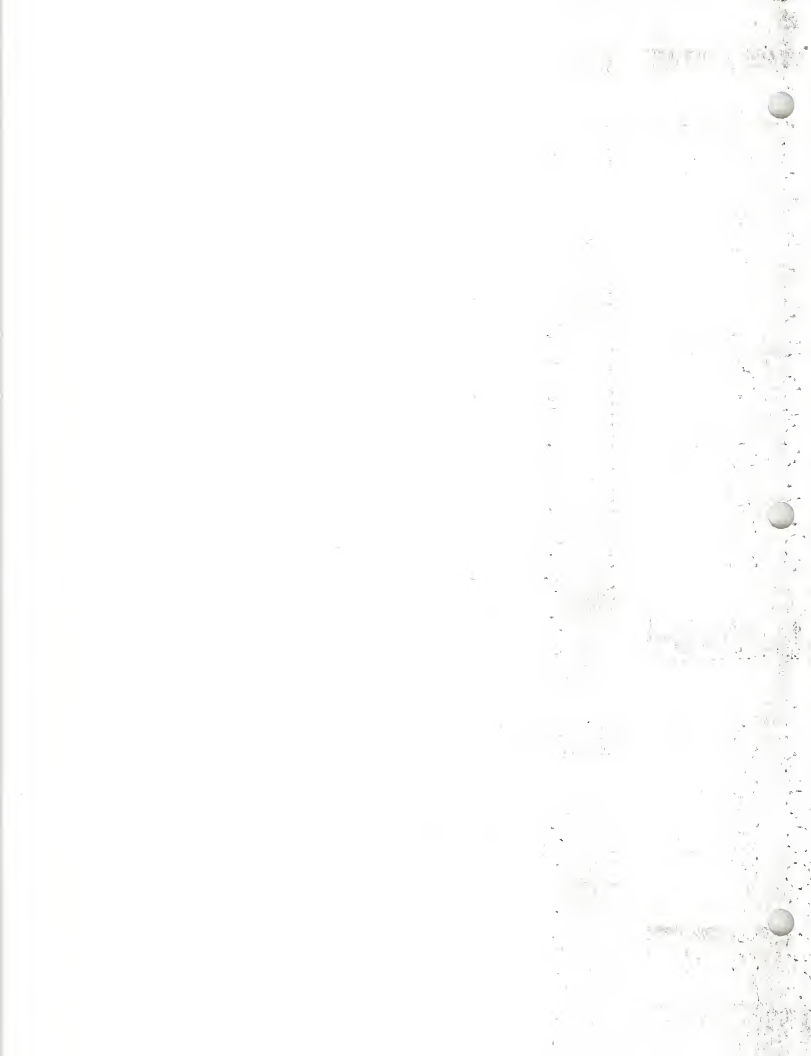


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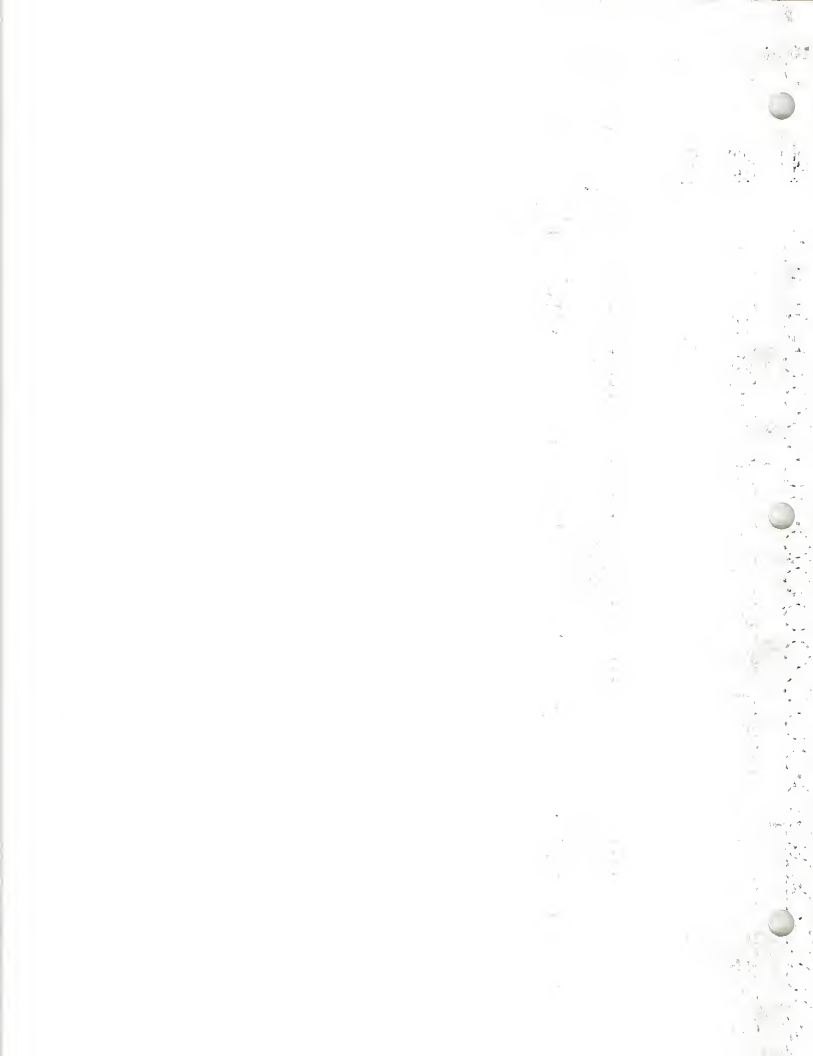
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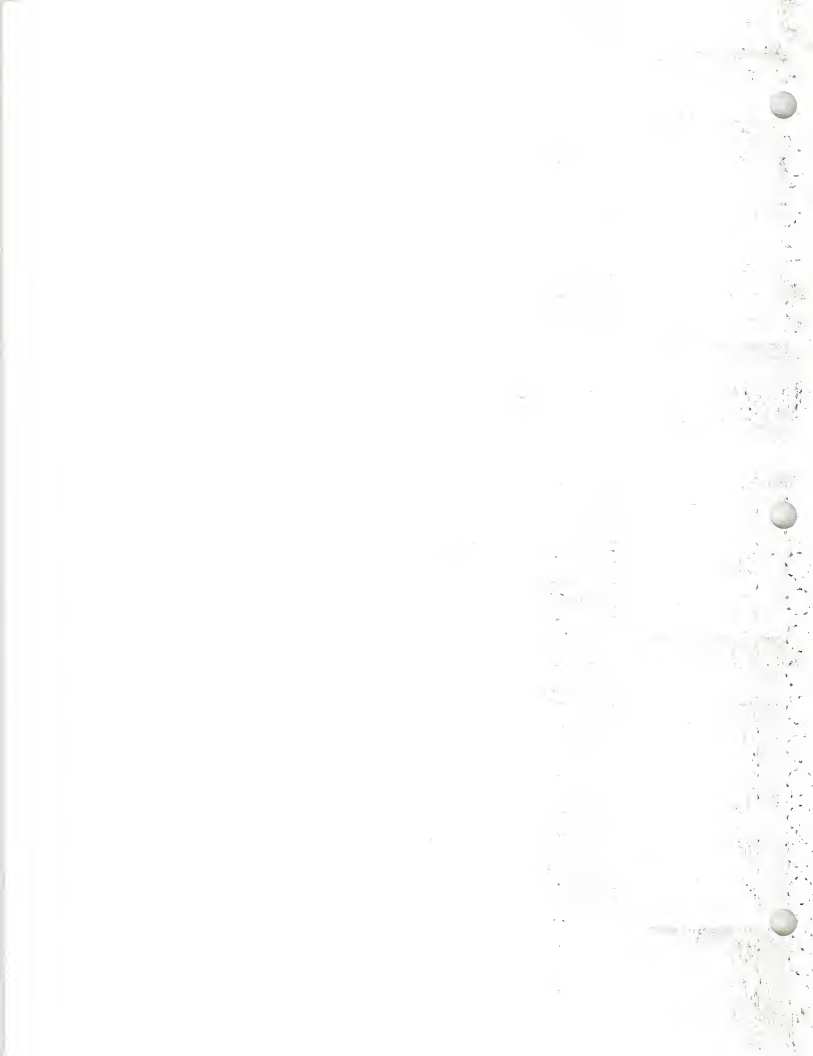
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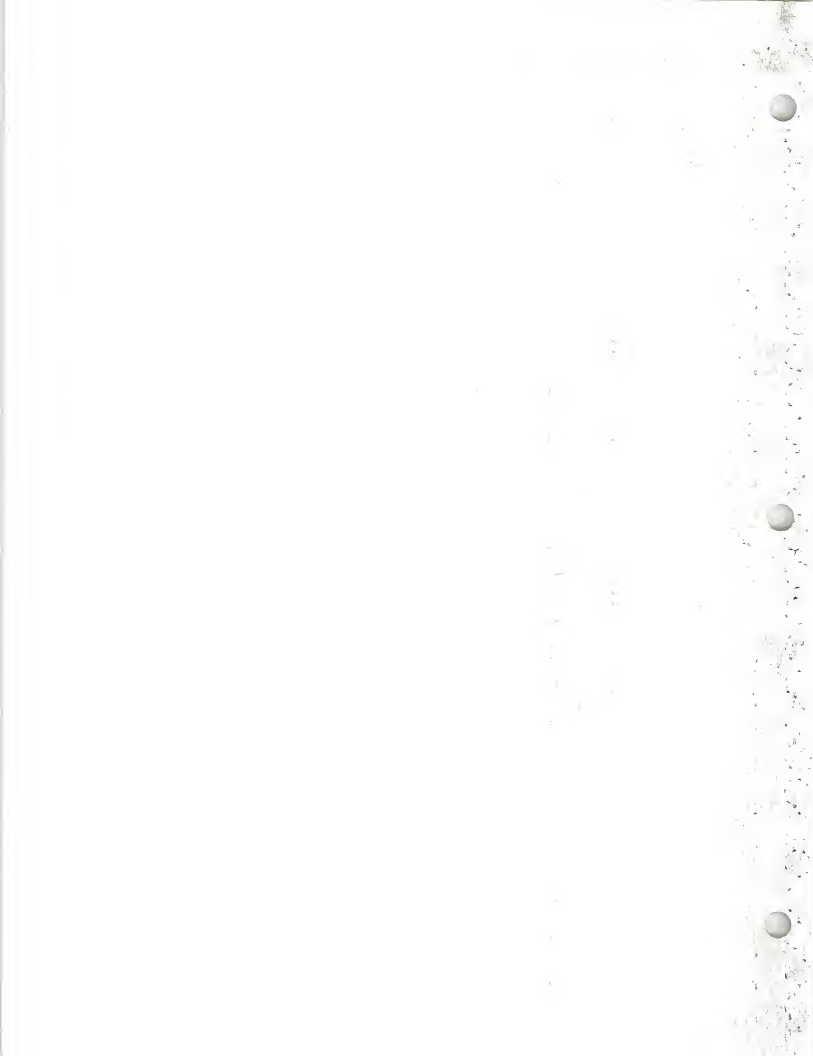
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